Training Manual

Multibeam Data Processing \ CUBE Module
CARIS HIPS and SIPS Professional 11.3

Teledyne CARIS Website: www.caris.com
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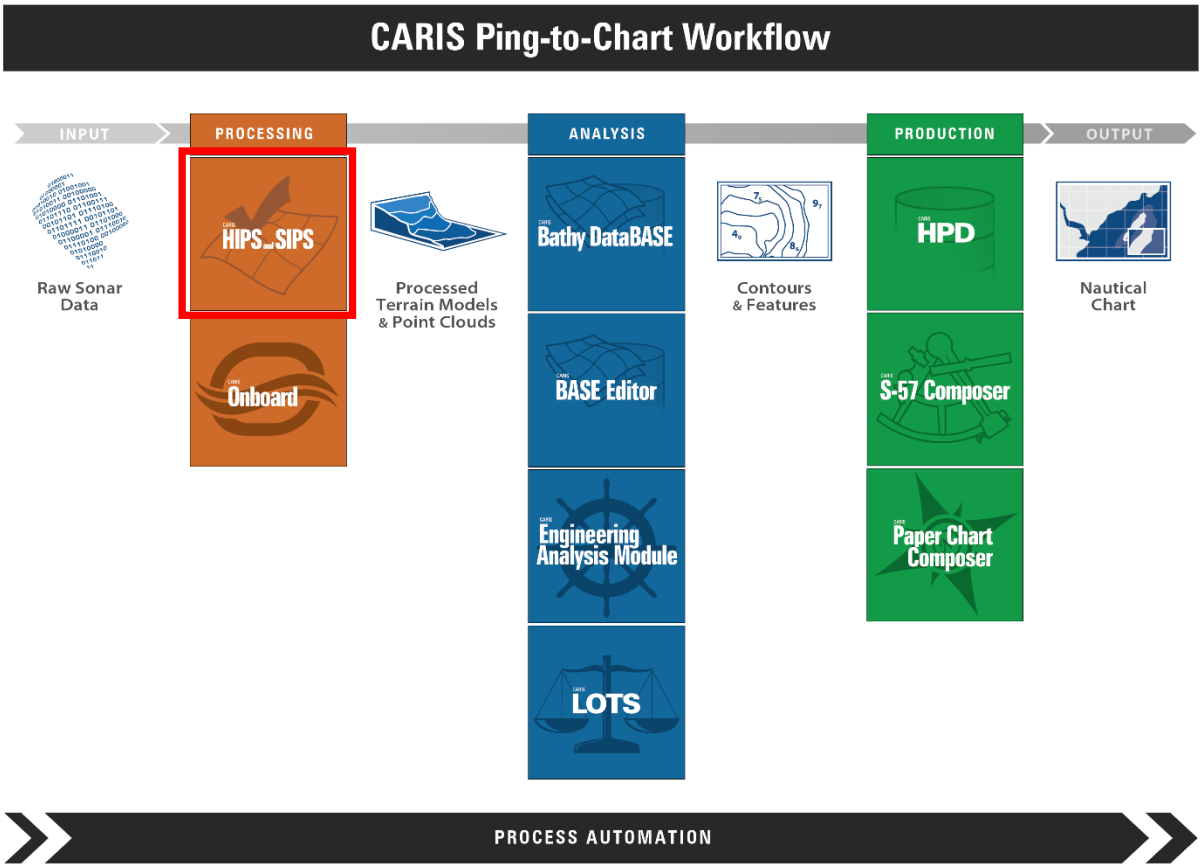
Contents

Introduction

CARIS[1] HIPS[2] and SIPS[2] Professional is a comprehensive suite of processing tools tailored for the review and correction of bathymetry and imagery data and product creation. These training course notes cover multibeam sonar data processing.



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Acknowledgements

The multibeam training dataset used in this course was provided by the National Oceanic and Atmospheric Administration (NOAA) and collected during the 2011 field season of the NOAA Ship Fairweather. The data used in these training exercises was collected by two of the Fairweather's Hydro Survey launches.

Note: These data are provided for training purposes only.

Recommended PC System Requirements

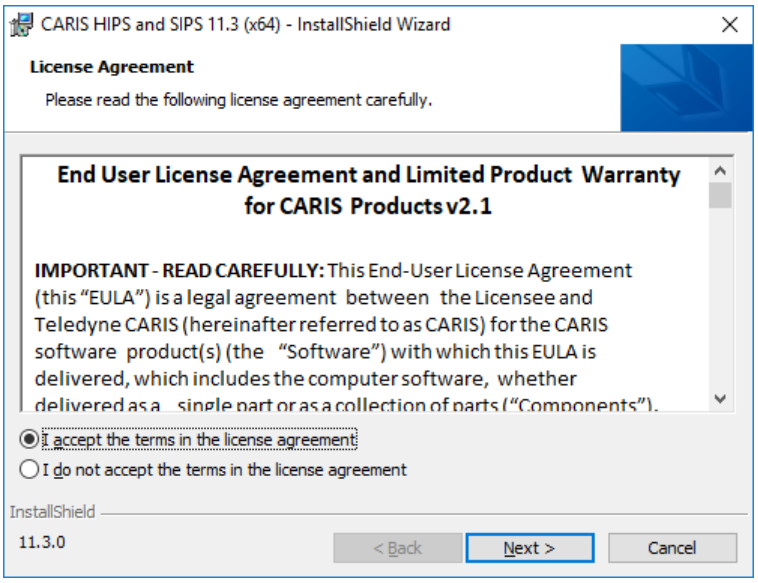
At the time of the HIPS and SIPS 11.3 software release, the recommended PC system requirements are:

- Processor: Recent generation multi-core CPU
- Memory: 16 GB of RAM
- Hard Disk: 7200 RPM disk drive or Solid State Drive, minimum 1 GB for installation
- Display: NVidia® or AMD® display adapter, with an OpenGL 3.3 compatible GPU, with 2GB of memory or greater and the most recent drivers for the adapter*
- Operating Systems: Windows® 10 Professional 64-bit

* Installing updates for the operating system can cause changes to the drivers installed on the computer for the display adapter. If you are experiencing display problems, verify that the drivers for the display adapter are up-to-date

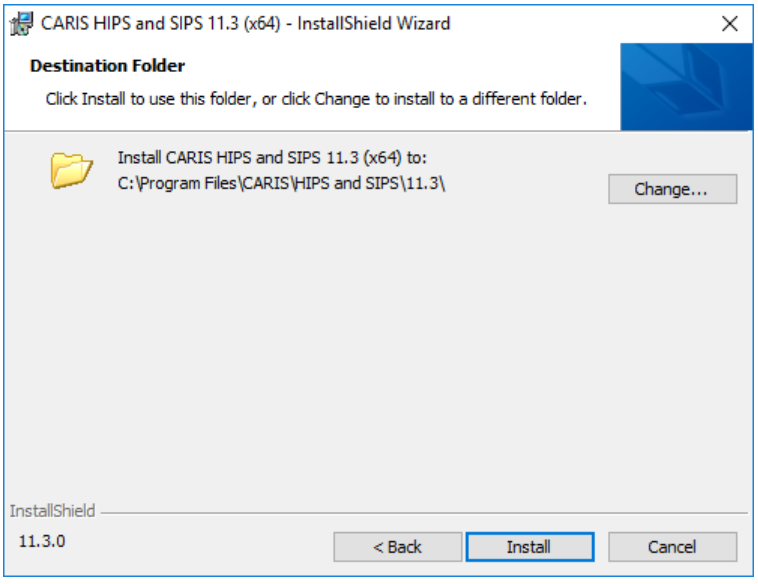
For the latest system requirements for HIPS and SIPS, visit www.teledynecaris.com

Installation



Exercise 1.

a. Double-click the Setup.exe file, select the option **I accept the terms in the license agreement**, and click **Next.**



b. Select the path for software installation. Click **Install**.

As of version 8.1, HIPS and SIPS is installed to **…\Program Files\CARIS\HIPS and SIPS\<version>** by default. The person installing HIPS and SIPS will require certain administrative rights to access this location. Therefore, files that you may customize from the

application (e.g., Colour, System, and Template files), are installed in a location accessible to most users: **…\ProgramData\CARIS\HIPS and SIPS\\<version>**.

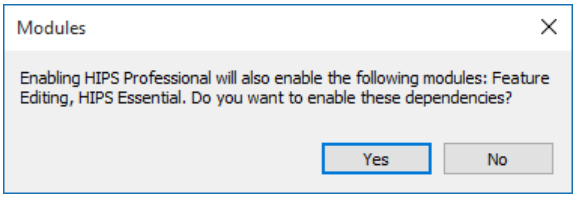
Note: If HIPS and SIPS is uninstalled, any custom files of the same name as the system files in the ProgramData location will also be removed.

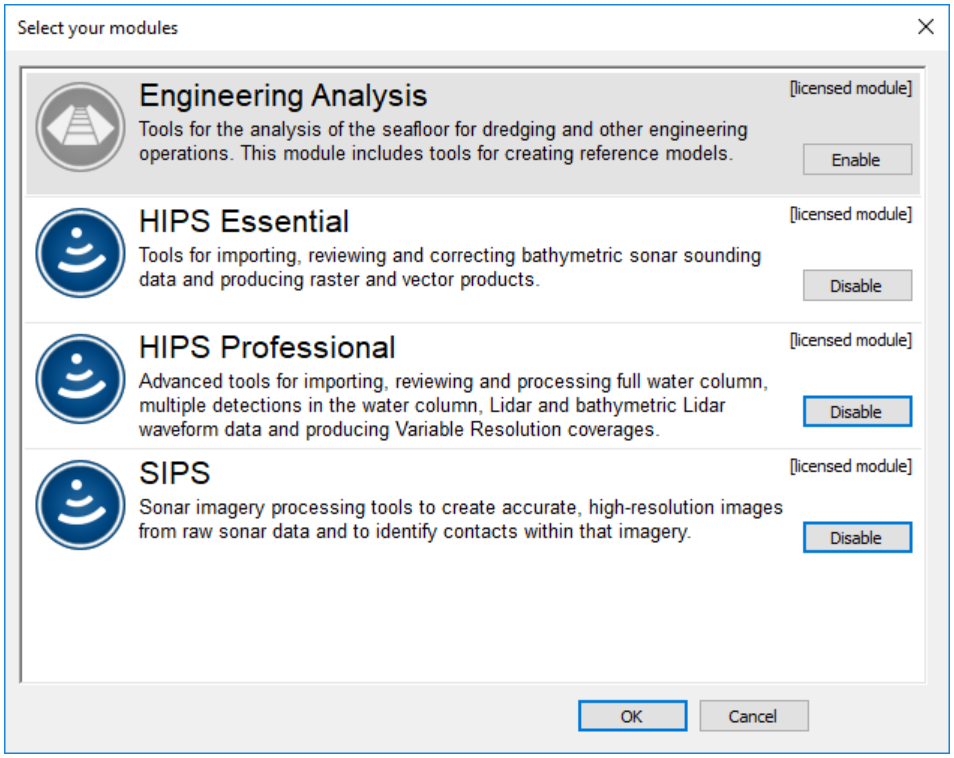
First Run

When opening HIPS and SIPS for the first time you will have to define the mandatory parameters.

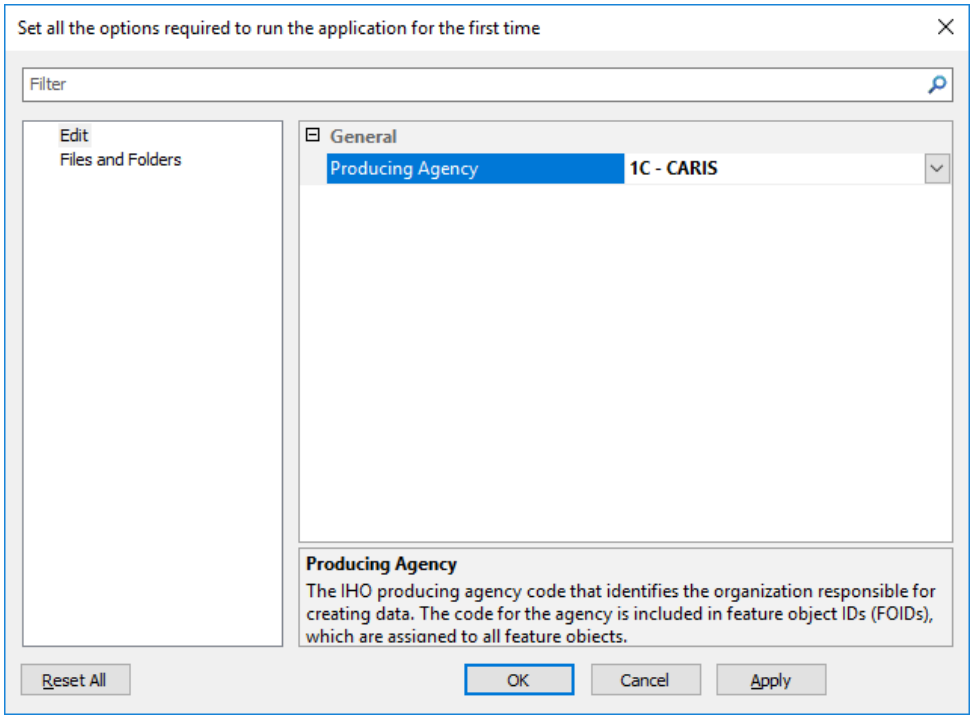
Exercise 2.

a. Start **HIPS and SIPS** from the Windows Start menu, select **All Programs > CARIS > HIPS 11.3**



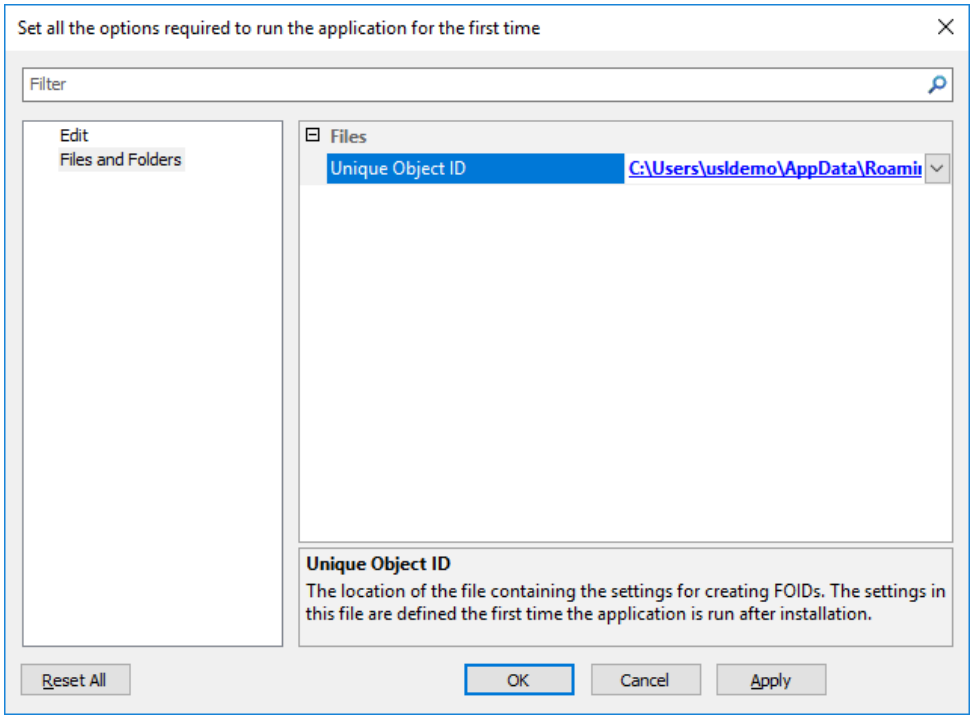


b. Click **Enable** for **HIPS Professional** (Click **Yes** on the pop up window) and **SIPS** modules. Click **OK**



c. Select **Edit**, click **Product Agency** and clicking the down arrow choose **1C - CARIS** from the drop down menu.

You can look for the Code of the Agency from the drop-down menu. It can be changed later in **Tools > Options**.



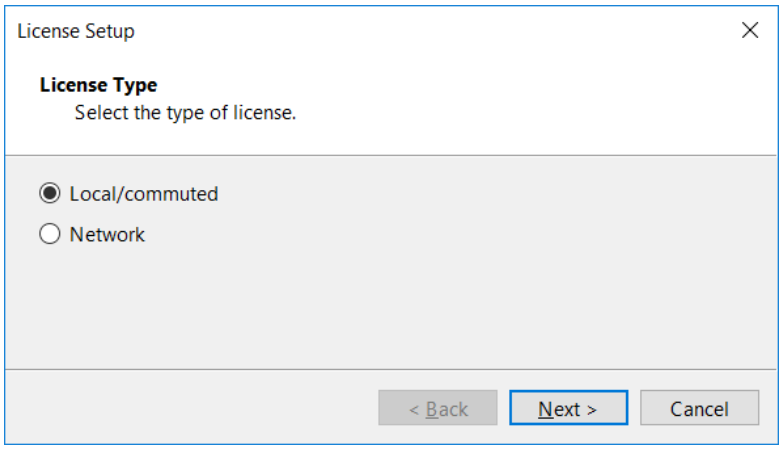
d. Select **Files and Folders**, click **Unique Object ID** and choose **Create Automatically** from the drop down menu

e. Click **OK**.

Local License

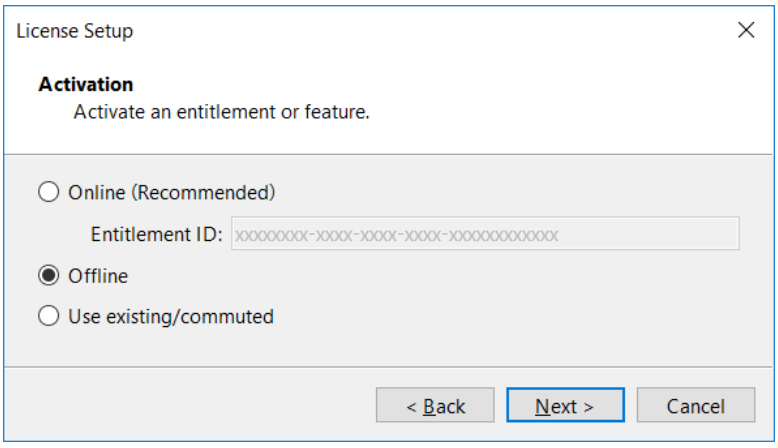
Local licenses must be activated before they can be used. Online activation can be completed using the Entitlement ID provided in the entitlement certificate email included with the purchase of a Teledyne CARIS application.

If you are using a computer that is behind a firewall and does not have access to the Internet, Offline activation will need to be performed. In this situation, the license will need to be activated by a license administrator on another machine with internet access and then entered in this wizard.

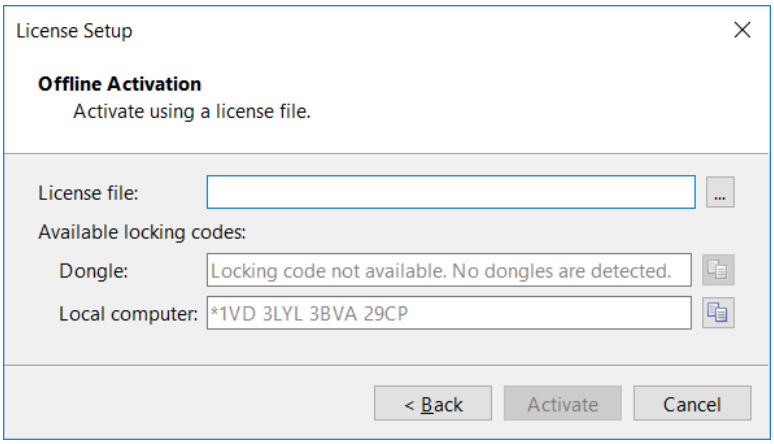


Exercise 3.

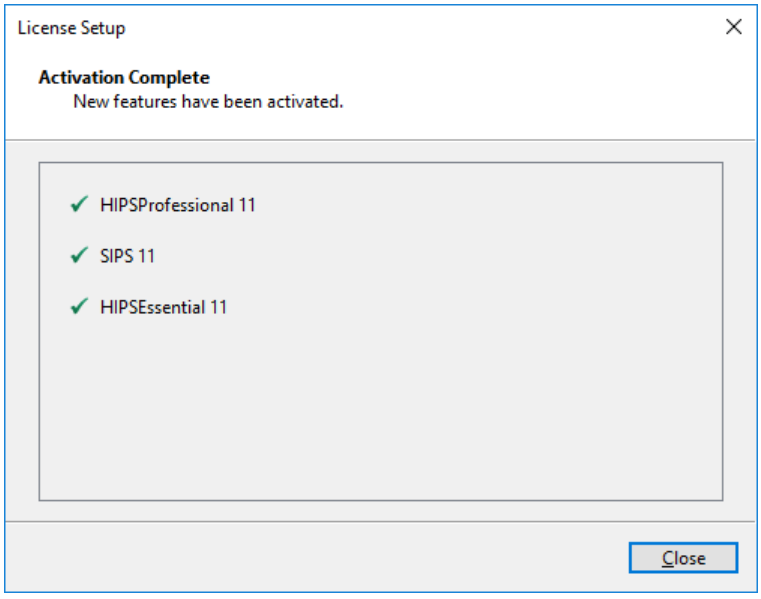
a. Within the License Setup dialogue window, select the **Local/commuted** radio button, click **Next**.



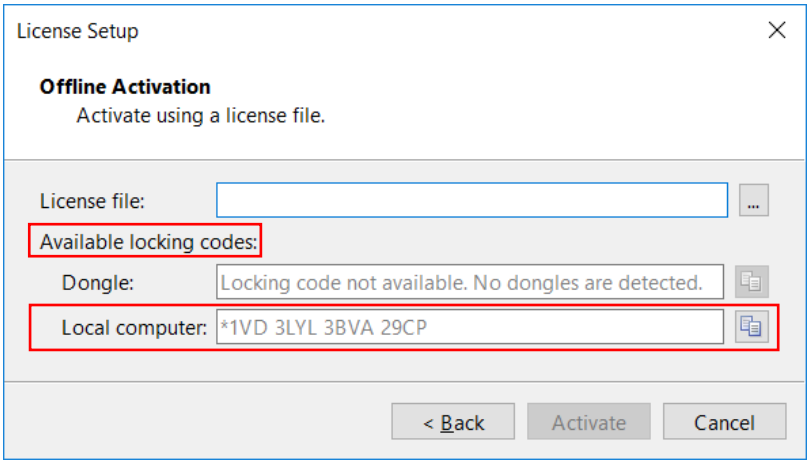
b. Select the **Offline** radio button and click **Next.**



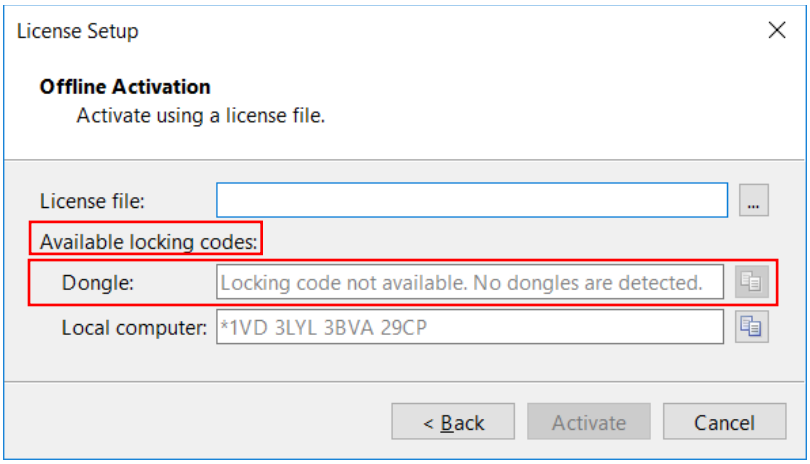
c. Select the **… browse** button beside License File and browse to the file the CARIS trainer has provided, click **Activate**.



All the licensed modules should appear with a green Check mark on the list.

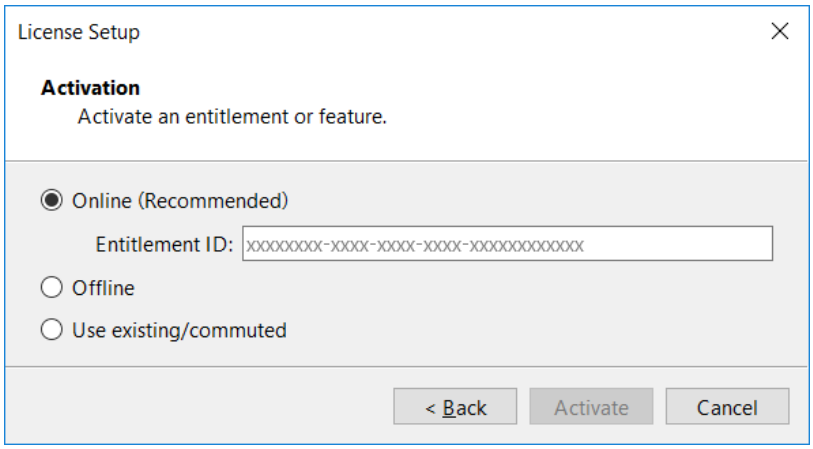


Note: Offline is used if internet access is not available on the workstation of interest, in these cases, users can send Teledyne CARIS the **Available Locking Code: Local computer**, a License File will be return, which will only work on the workstation the Locking Code was obtained from.



Note: A physical local dongle can also be used; the dongle will act as the locking code, instead of a locked code for the actual workstation. All users that expect to use this dongle should complete an offline license file activation, and then when the dongle is physically connected to one of these workstations, it would recognize the locking code from the dongle, instead of the workstation.

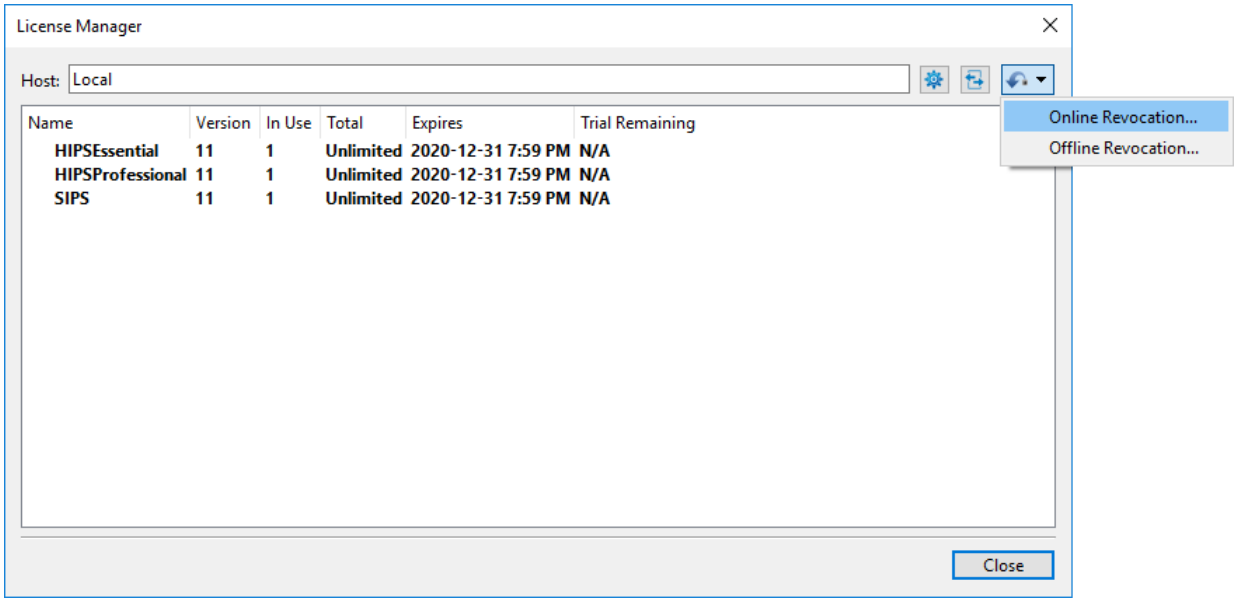
This licensing is recommended in a ship environment, especially when the surveying location likely will have minimum to no internet connection.

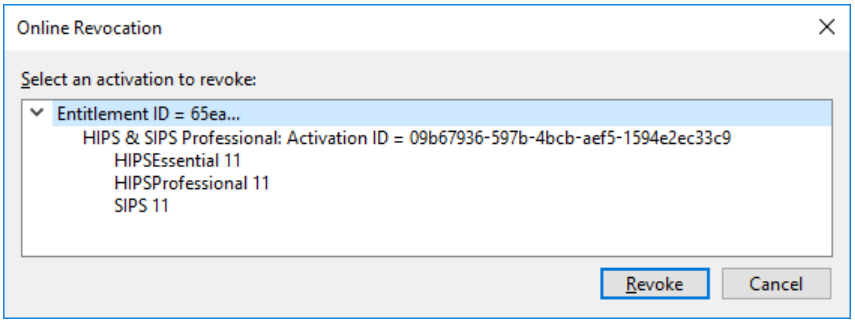


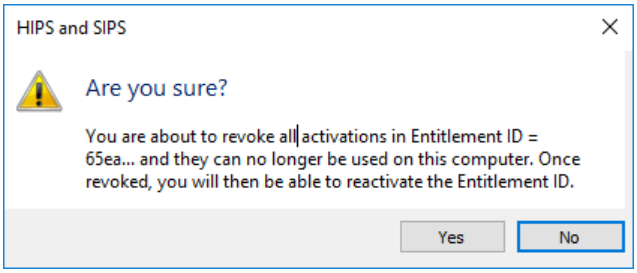
Note: Selecting the **Online** radio button to enter an **EID** provided by Teledyne CARIS prior to license activation. This option can only be utilized if the workstation has internet access during license activation.

Revoking licenses

With the release of **HIPS 11.2.4**, local licensing can now be revoked. This is useful when it has been decided that software will not be used on a system after licenses had been activated on that system. If an online connection is available, the license server can be contacted directly and all the information can be efficiently confirmed to completely revoke the license activation (**Online Revocation…**).



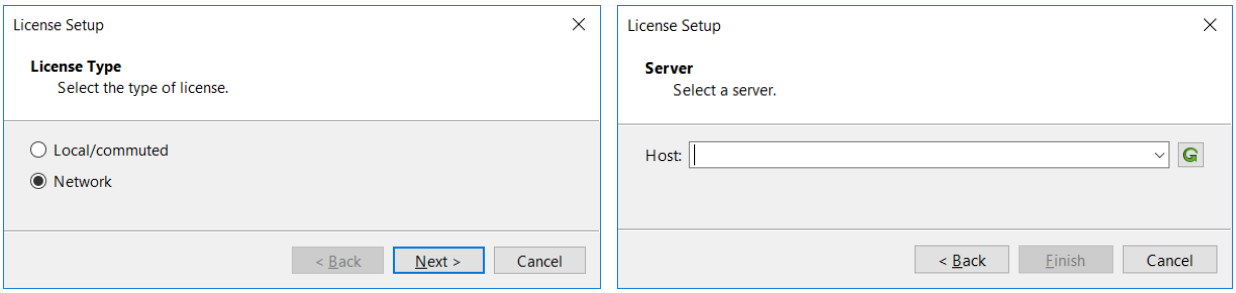




Otherwise, a multi-step process is required to transmit encoded license information to and from the license administrator to ensure the system and license server have synchronized information about what licenses are active on the system (**Offline Revocation…**).

Note: For Offline Revocation, please contact Teledyne CARIS support (caris-support@Teledyne.com)

Network Licenses



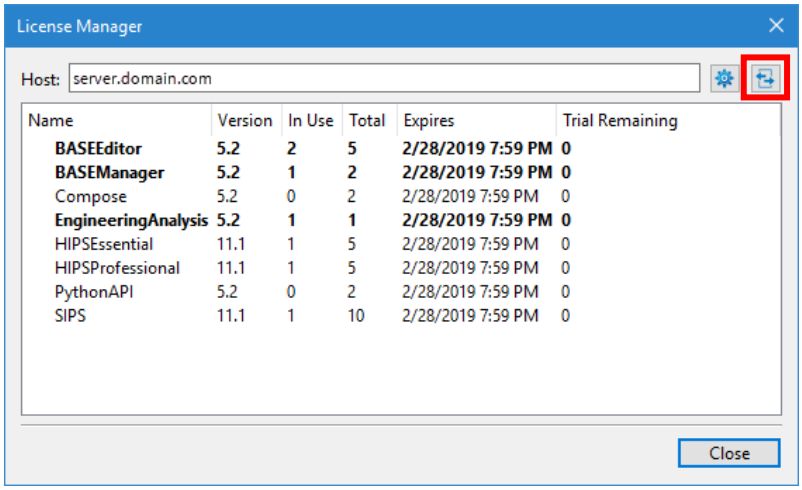
If the **Network** radio button is selected, the available servers on your network can be selected from the Host drop down list. The Refresh button is used to update the list of available servers if the license for the server was activated after this dialog box was launched.

Note: If you are attempting to connect to a Server via a Wi-Fi (wireless) connection, you will not see the Host drop-down list populated automatically. You would need to type either the Server machine name or its IP address.

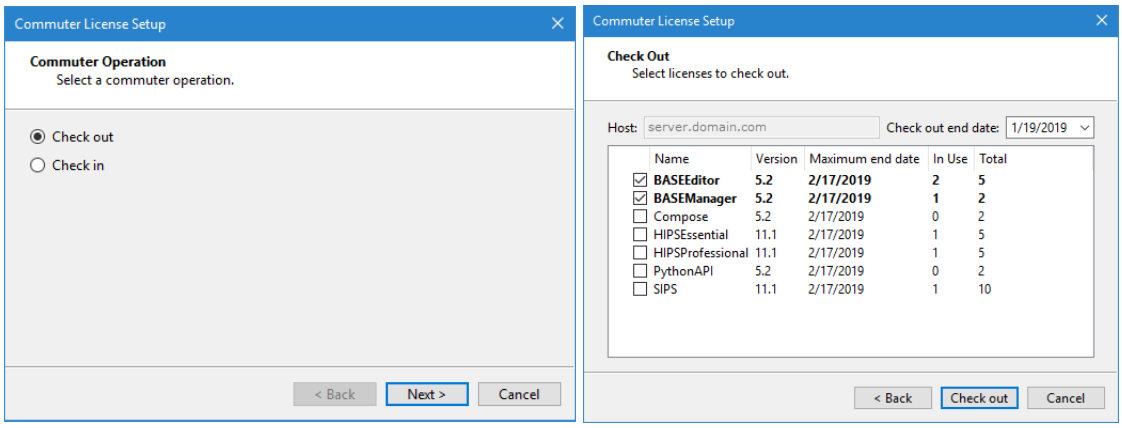
Note: For network firewall, you will need to make sure that **Port 5093** is open for both the Server machine and the client machine. This Port is used for the network license.

Commute

A commuter license allows a network license to temporarily be used as a local license. This is ideal for users working away from their local workstation without access to a license server.



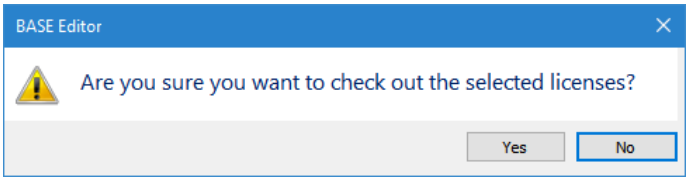
A commuter license is created by performing a check-out from a license server. A check out creates a license file on the local machine containing the details of the license. This action needs to be performed on the computer that will utilize the commuter checked out license.

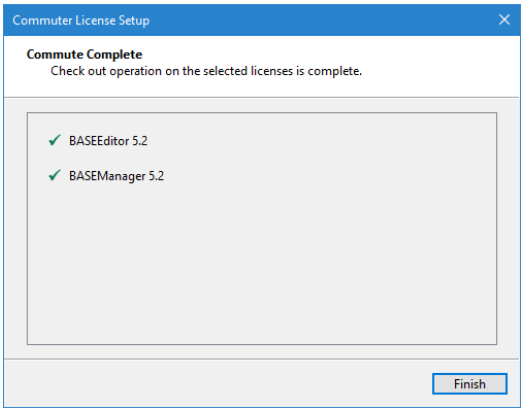


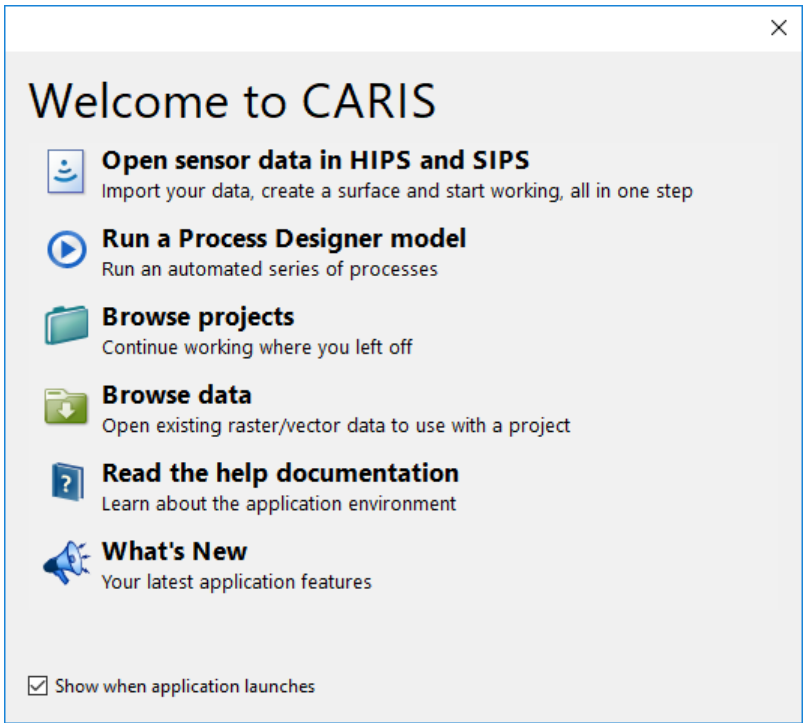
During check out, the user selects which licensed modules to include in the commuter license. This can be any module license that would normally be available on the license server with a network commuter license. The license server contains a limited number of licenses for each module. When a license has been checked out, the License Manager will show that the license is in use and is not available to other users. If all licenses for a module are already in use, this module cannot be checked out.

Note: A Check out end date must also be set, this can be up to 90 days from the date of check out. If the use of the commuter license is not required for the full duration, it can be checked back into the network license, the workstation with the commuter will have to reconnect to the network to complete a check in.

Furthermore, once the Check out end date has been surpassed, the Commuter license will be considered expired and the Network license will automatically regain this license.







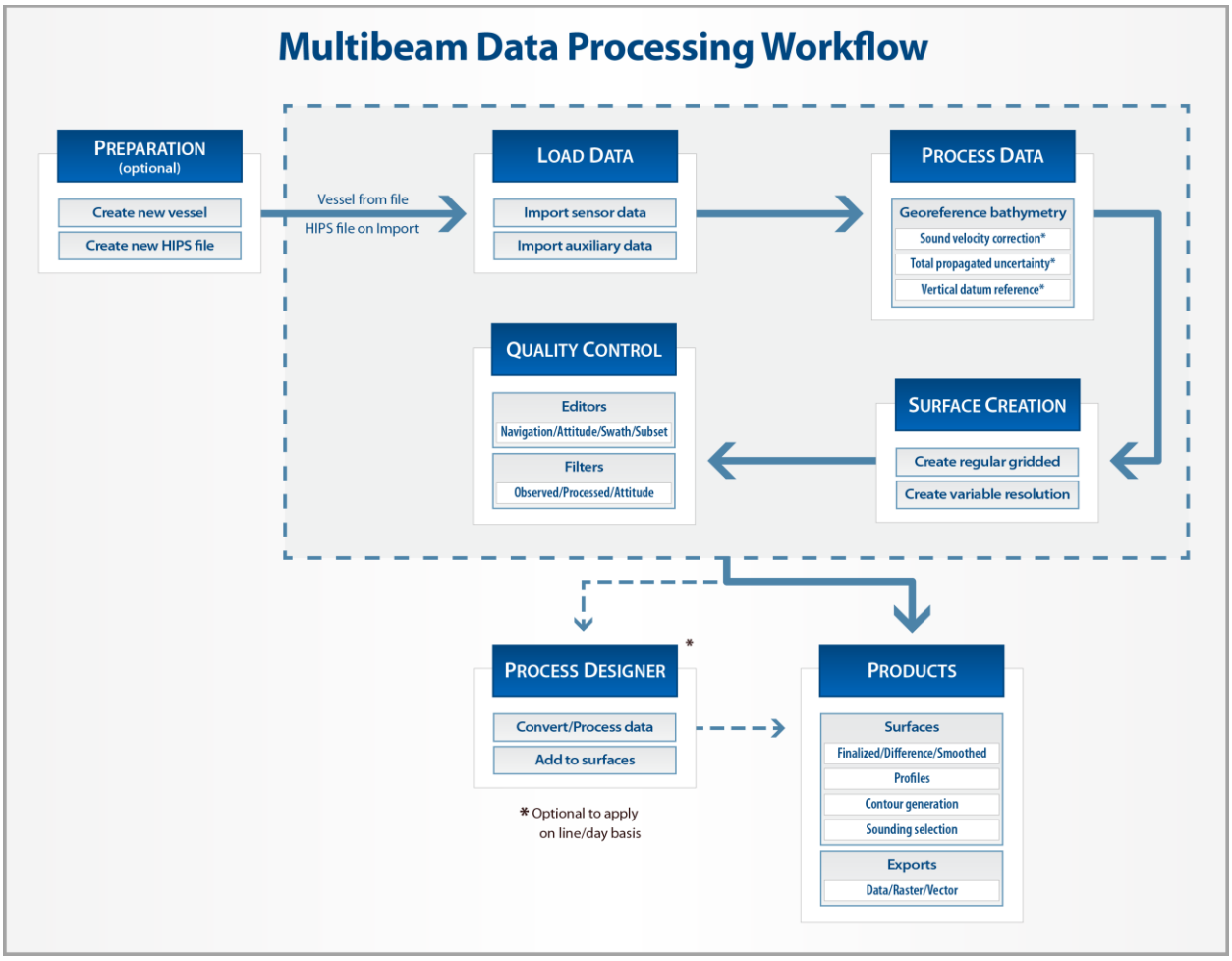
Now you will see the Welcome window, which provides shortcuts to:

- Go to Import Sensor Data directly
- Run a Process Designer Model
- Browse and open Projects
- Browse and open Data
- Open Help Topics (Website)
- See the Changes list from the new version installed.

In addition, you can disable the check box "**Show when application launches**" and then next time opening the software you will not see this Welcome Window again.

Multibeam Data Processing Workflow in HIPS

The following section contains information about the workflow that this training follows and specifics of the dataset provided for training purposes.



Multibeam processing workflow follows these major steps:

- **Create a Vessel File** (Optional): Setup the sensor locations and uncertainties in the vessel reference frame.
- **Create a New HIPS File** (Optional): Setup the HIPS Data Source.

  ***Vessel File and HIPS file, can optionally be created on Import**

- **Import Sensor Data**: Import raw data into HIPS data format.
- **Import Auxiliary Data:** Import extra post-processed data, like Delayed Heave, post processed Navigation and Motion, and Real Time (RMS) Uncertainty data.

- **Save Project**: Save the current workspace (data and current view).

- **Georeference Bathymetry**: Combine vertical and horizontal information to produce geo-referenced data, as well as;
    - **Sound Velocity Correction**: Load and edit sound velocity profiles and apply the correction
    - **Load/Compute Tide**: Load tide data from one or more tide stations or compute GPS Tide
    - **Compute TPU**: Utilize uncertainty values entered in the HVF in an effort to compute the total propagated uncertainty of each individual sounding

- **Create Regular Gridded Surface**: Produces Regular Grid Surfaces (single resolution value), using different techniques; Swath Angle, Shoalest Depth True Position and CUBE.
- **Create Variable Resolution Surface**: Produces a resolution map, defining tiles and corresponding resolutions based on target point density (CARIS or Calder-Rice density algorithms) or a predefined resolution table (CARIS Depth Ranges). Then selects the technique utilized to populate the values at the nodes of the VR surface using different techniques; CUBE, IDW, Mean, Select, Swath Angle and Uncertainty.

- **QC Editors**: Besides individual sensor QC, such as navigation, gyro, heave, etc., georeferenced soundings are edited directly (Subset Editor) if problems have been identified in the surface.
- **QC Filters**: Filters Observed or Processed Depths using swath geometry, IHO survey orders and/or Surfaces. Also filters all Attitude (including navigation) data.

- **Products Surfaces**: Finalized surfaces (with designated soundings, carried through to bathymetric products), Difference surfaces and Smoothed Elevation Bands, are obtained from the original surface.
- **Profiles:** Generates a 2-Dimensional vertical profile of a single Surface or multiple surfaces for comparison
- **Contour Generation**: Creates contour lines from surfaces (usually Generalized). As an optional step, contour areas could be created in this step too.
- **Sounding Selection**: Selects some soundings based on radius and\or chart scale.
- **Exports:** HIPS soundings can be exported (Data), as well Raster Surfaces and Vector objects Created (HOB), to various formats for data transfer.

- **Process Designer** (Optional): Additionally this semi automatic tool can import and apply all the processes made at this point to additional lines (days or vessels), and add the resulting processed lines to the existing surfaces.

Survey System / Data Information

The following is a summary of the sensor offsets for the equipment on vessel and information about the data collected, including ancillary data.

Sample Data Set

- Teledyne RESON SeaBat 7125, Multibeam Sonar, 512 beams.
- Vessel: FA_2807_Reson7125
- Multibeam Sensor set-up date: March 09, 2011 (Julian Date 2011-068)
- Date Collected: March 31, 2011 and April 01, 2011 (Julian Dates 2011-090 and 2011-091).
- Raw data in HSX format

Sensor Offsets

- Transducer1: dX = 0.019, dY = 0.244, dZ = 0.481, Roll = 0.100, Pitch = -1.490 and Yaw = 0.500
- Navigation: Time Error = 0.0, dX = 0.00, dY = 0.00 and dZ = 0.00, Ellipsoid=NA83
- Gyro: 0.00
- Heave and Pitch: dX= 0.00, dY= 0.00, dZ = 0.00, Apply=Yes
- Roll: Apply=No
- Draft: Apply=Yes, Table included
- SVP 1: X = 0.019, Y = 0.244, Z = 0.481, Roll = 0.000, Pitch = -0.000 and Yaw = 0.000
- Waterline Height: Waterline = -0.090, Apply=Yes

Positioning information

- Data in geographic coordinates.
- Referenced to NAD 83.

Rawness of data

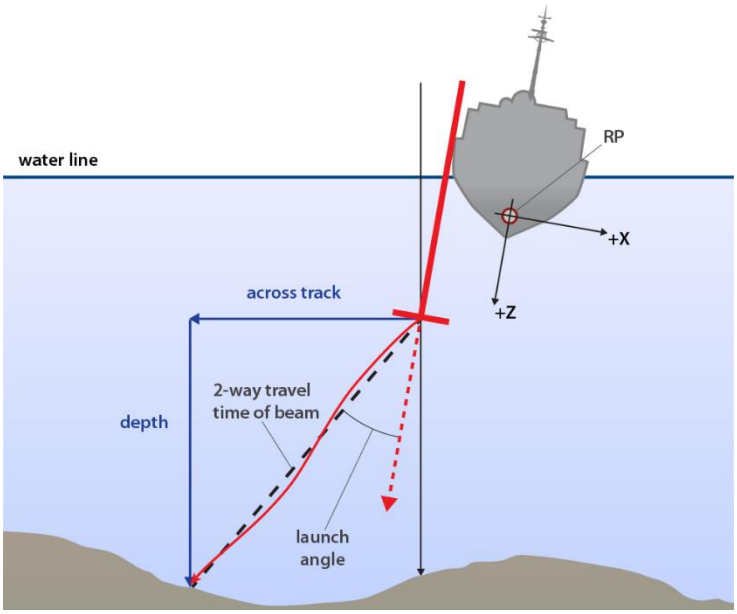
- Data are roll-compensated only, but not corrected for any other vessel motion.
- Offsets for navigation lever arms, are compensated for in the POS/MV.
- Travel time and angle information is available.

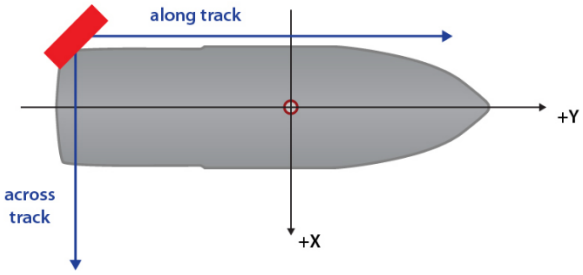
Relevant Ancillary Data

- Delayed Heave: 2011_090_2807.000 and 2011_091_2807.000
- Tide data: Seattle_9447130_20110318_20110502.tid
- SVP data = H12281_2807.svp
- Navigation = 2011_090_2807.sbet and 2011_091_2807.sbet
- Real Time Uncertainty data = 2011_090_2807.smrmsg and 2011_091_2807.smrmsg

Rawness of Data

There are certain systems, which have travel time and launched angles information available in the raw data, such that during import, this information can be imported to HIPS format and later used in the Sound Velocity Correction (SVC) step, which has been incorporated into the **Georeference Bathymetry** process, as shown below.





Some examples of the format/sonars currently available are:

- XTF = all Teledyne RESON sonars, Seabeam/Elac
- Hypack = most sonars
- XSE = Seabeam/Elac
- Atlas = SURF
- Simrad EM format
- SeaBeam mb41 format
- Imagenex

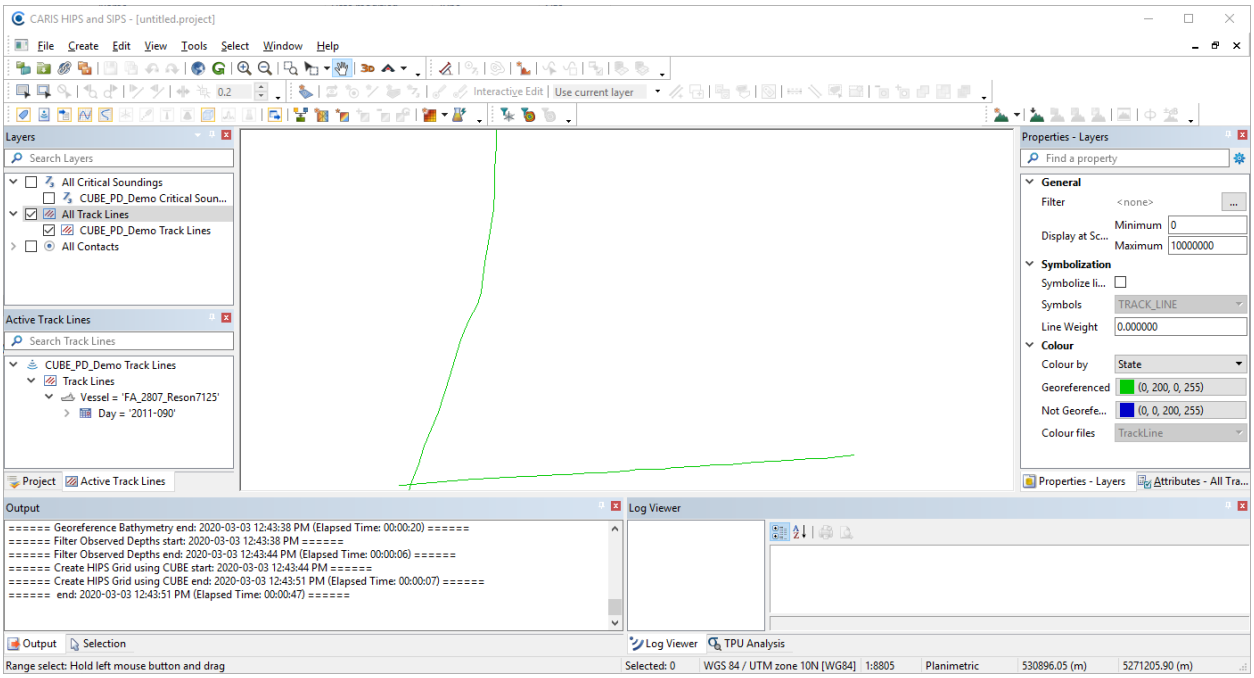
The availability of the travel time can be confirmed by the “Raw Range” flag when a line is queried.

Getting Around in HIPS

The HIPS and SIPS interface is very similar to other CARIS applications. It is made up of moveable windows that contain a variety of information. Additionally, there is a wide range of options that you can specify. The purpose of this section is to orient you with the HIPS interface.

The User Interface

The default graphical interface for the HIPS and SIPS is shown in the image below.



Familiarize yourself with the various work areas, menus, and toolbars.

All windows can be set to either a docked position or a floating position. In the docked position, windows appear as a single window and the main application window can be moved, minimized, and maximized as such.

In the floating position, windows “float” freely on the screen. Each window is independently sizable and can be moved anywhere on the screen.

The docking controls allow you to dock windows in pre-defined locations within the program window. Take time to utilize the docking controls until you achieve a desirable result.

File Open / Drag and Drop

Since the release of HIPS and SIPS 11.0, it supports some sonar formats to be opened directly from the raw files, creating a zero-vessel file (**Vessel from Data**) and doing the following processes automatically:

- Import to HIPS
- Georeference Bathymetry (Load no Tide)
- Create a Variable Resolution Surface from the data.

The formats we're supporting so far to do this "**File Open / Drag and Drop**" function, are:

- Hypack HSX data
- Kongsberg ALL data
- Kongsberg KMALL data
- Laser-Scan Internal Feature Format (IFF)
- Sonardyne SWF8 data
- Teledyne PDS data
- Teledyne S7K data
- Triton XTF data

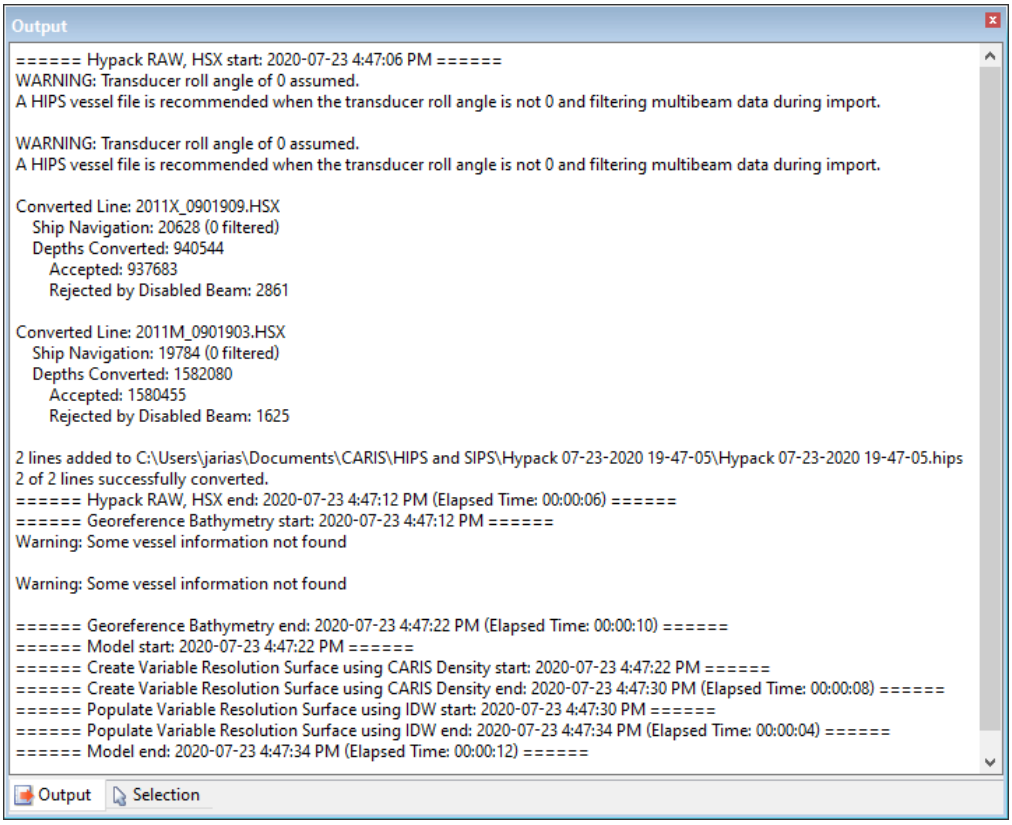
Note: File > Open > File / Drag and Drop allows the user to create a **HIPS Data Source** and **Surface without knowing anything about the source data** (resolution, vessel configuration, tide, SVC, etc.), presenting the user with a **faster route to initial data analysis** then in previous version (no preparation required).

While utilizing this method of HIPS Data Source creation, it will default to the following location; **C:\Users\'username'\Documents\CARIS\HIPS and SIPS\"version'\'HIPS Data Source'**

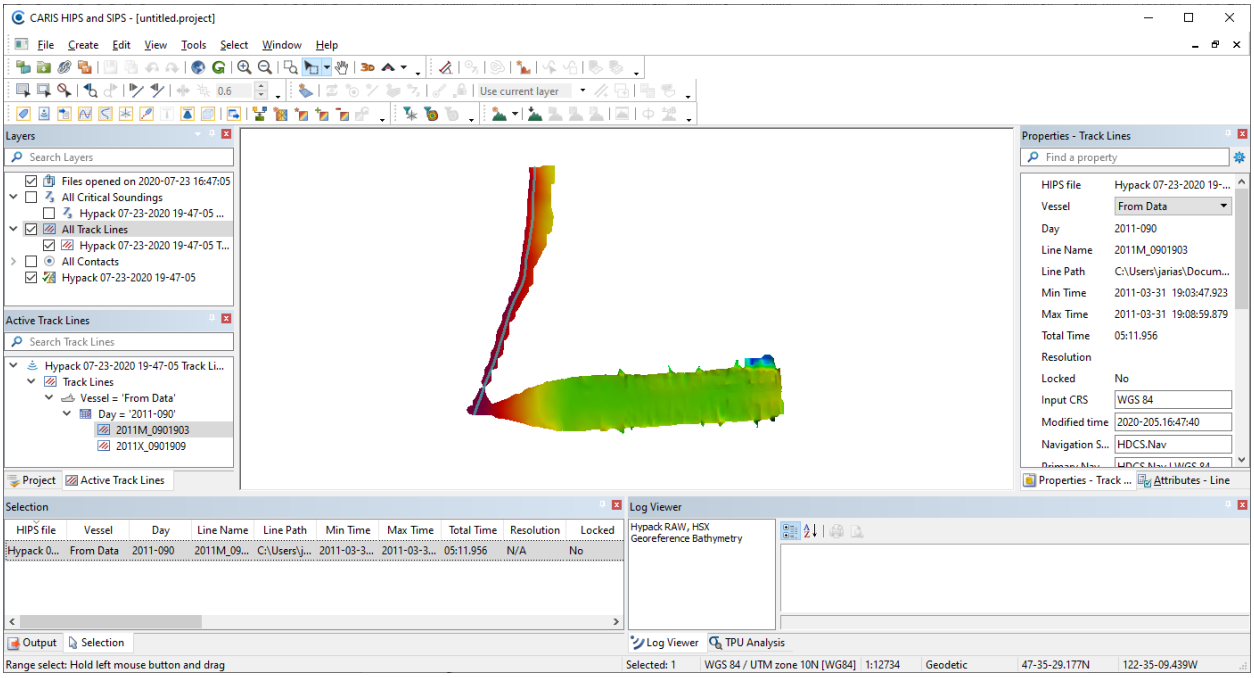
Exercise 4.

a. Within windows explorer go to **…\HIPS\PreProcess\CUBE\Hypack\2807\DragNDrop** and select the two files with **.HSX** extension, **drag and drop** it into the HIPS and SIPS display window.

Note: **File > Open > File** can also be used to automatically import the raw data formats listed above into a HIPS data source.

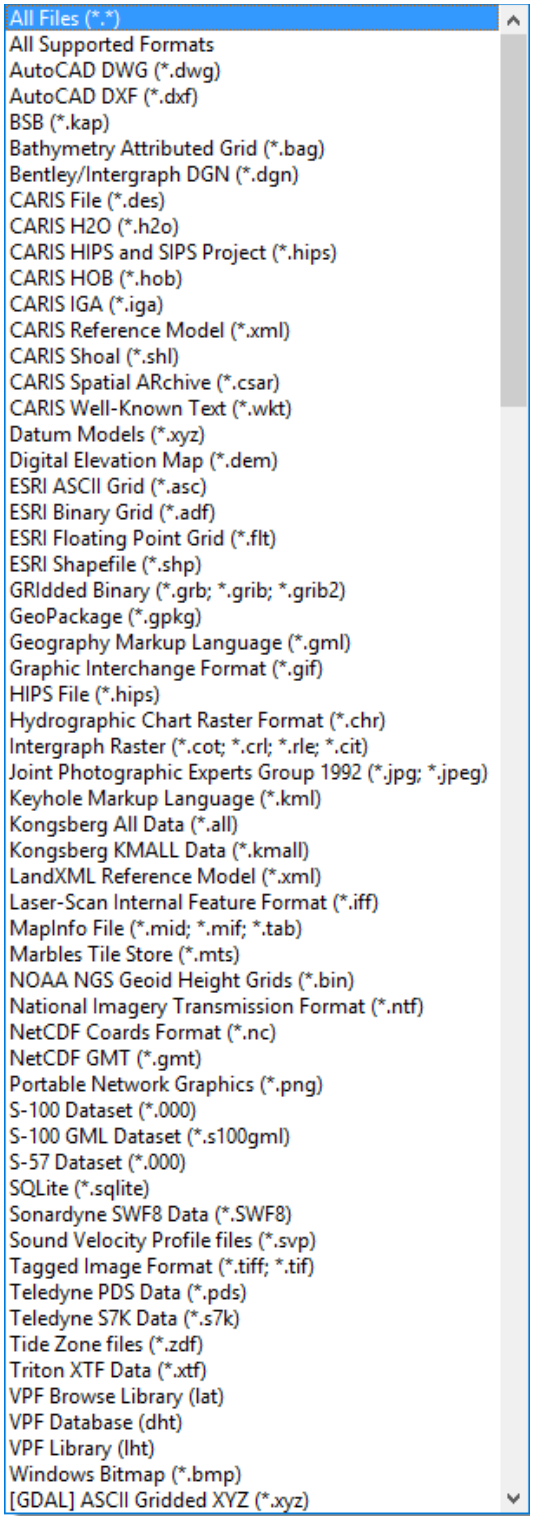


On **Output** window, you will get a report of all processes (Import, Georeference & Surface Creation) and Elapsed time for each one.



Open Data

HIPS and SIPS supports many raster and vector formats that can be opened in the working environment.



Exercise 5.

a. Click the **Open** icon to open the generated Surface, or choose the **File > Open > File...** menu.

b. Browse to the directory **…\Training\HIPS\Background\CUBE** and select the files **18474_1.KAP** and **US5WA14M.000** click **Open**. Click **OK** at the pop-up **S-57 Update Options** message.

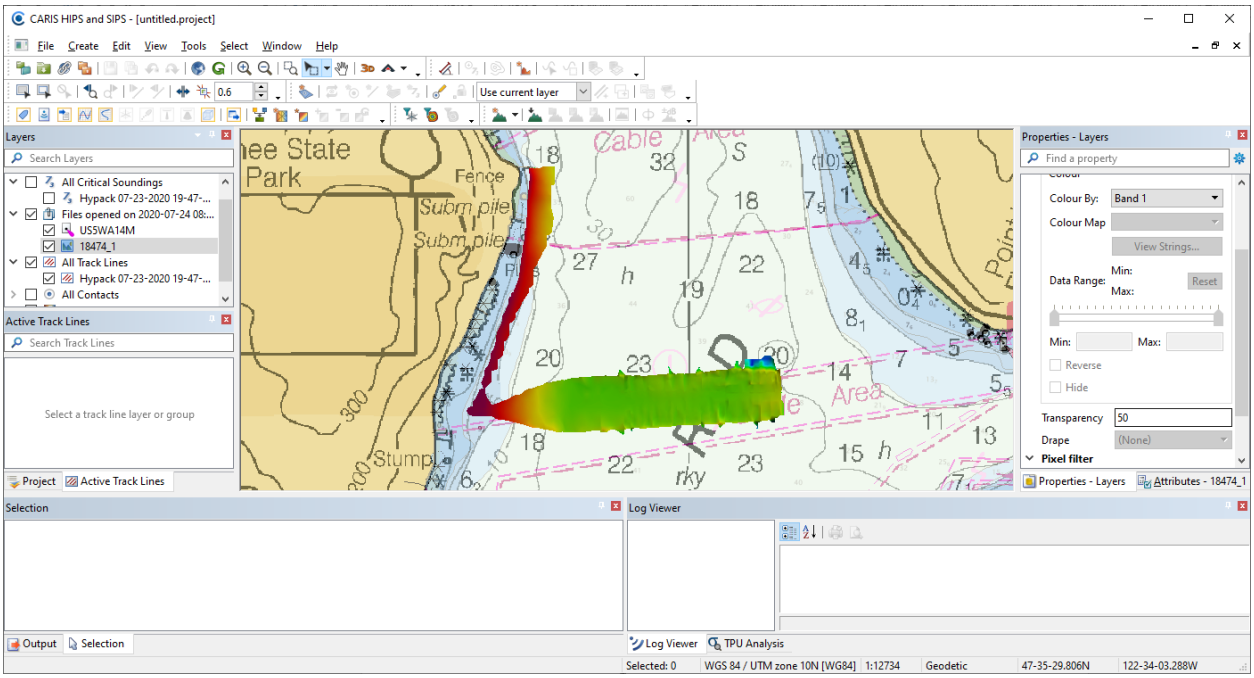
Other background data layers can be opened by changing the Files of Type selection.

Windows available in the graphical interface are described below.

- **Layers:** Lists all objects, coverages, filtered layers, and external data that are open in the application, and controls which data is visible (drawn) in the Display window. It is possible to toggle these layers on and off using the check boxes in the **Layers** window. The **draw order** of the layers can be changed by dragging and dropping a layer within the list of layer. The Layers window also contains a selection of right-click options (Filter, Extract, Group, Duplicate, etc.).

- **Project:** Displays the data in an expandable trees. These layers can be highlighted to gather metadata information about a raster coverage (source location, lineage, resolution, CRS, extents, etc.), or specialized information regarding an individual band within that coverage (range in value). The Project window can also be used to add attribute and band layers to the Layers window and close entire source Layers.

- **Active Track Lines:** Displays HIPS Data Sources (HIPS file) in an expandable tree, showing HIPS file, Vessel Used, Day and Lines. Note that the day now is automatically selected by the timestamp of the data imported. Highlighting data in this window, shows all metadata related with.



Exercise 6.

a. On the **Layers** window, highlight the group **Files opened on…** parent layer and move it to the top of the list (Holding the left bottom of the mouse and release on the desired position).

Note that All Critical Soundings and All Contacts layers are disabled because they are empty, you do not have any objects at this point on those layers. You can collapse those layers if you want.

b. Highlight the layer **US5WA14M** and move it to the top of the list, to display this layer as the first (back) layer.

c. Highlight the layer **18474_1** and move it as the second item on the list to display it on top of the ENC.

d. To visualize both Charts at the same time, highlight the layer **18474_1** in the Layer list and on the **Properties** window set the **transparency** to **50**

The Window is automatically refreshed and the display is redrawn.

- **Properties** - window will switch from **Layers**, **Project** or **Track Lines**, displaying information about selected objects on each window. Information shown in the Properties window depends on the selected object type. For **Layers** will show graphic properties of the selected object like colours, status, visual filters, etc. For **Project** will show metadata of the object like CRS, Extents, Resolution, Lineage and other metadata. For **Track Lines** will show other information like Vessel used, Input CRS, Navigation Sources, and status.

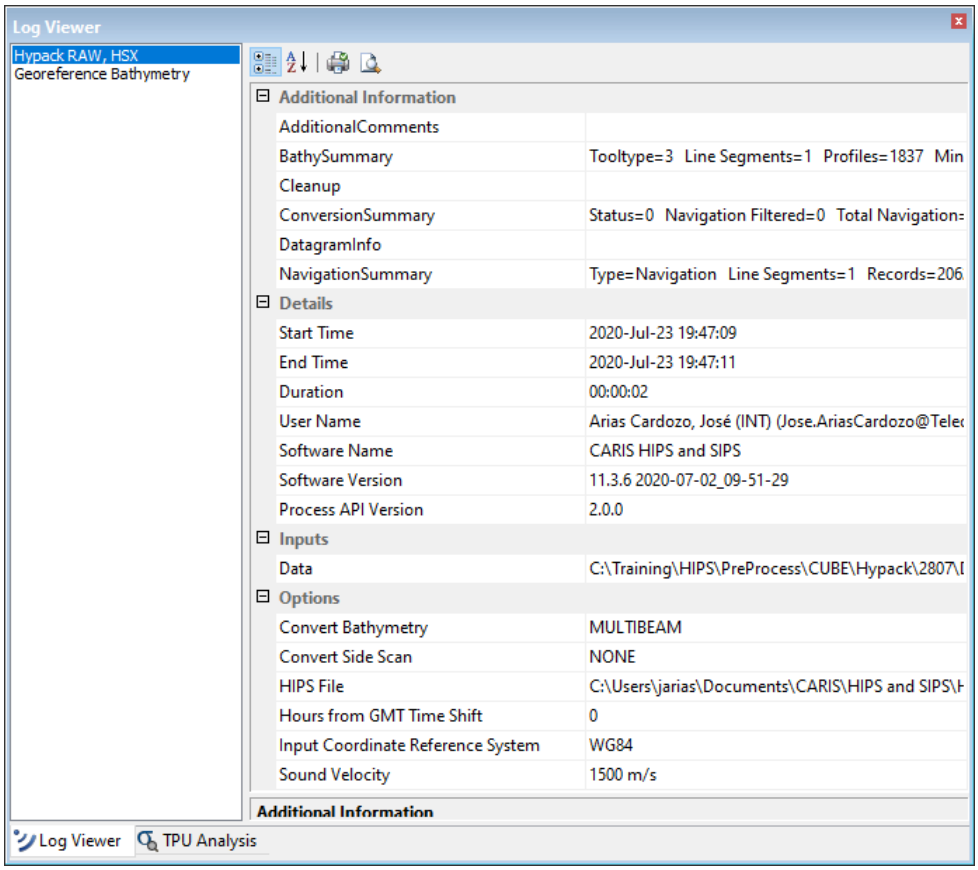
- **Attributes** window displays information about Attributes (S-57) selected objects in the Layers window.

- **Output** window at the bottom left of the interface is used to display status information regarding the task at hand. It is useful to check the Output window when importing/exporting data to ensure successful completion of the task.

- **Selection** window at the bottom center of the interface is used to list information about selected features. The information displayed for a selection depends on the type of object selected. More detailed information about the selected features is also displayed in the **Attributes**, **Components**, **Relations**, **Coordinates**, **Features**, and **Spatial Attributes** windows.

- **Display** window shows a graphical representation of a survey area. You can work in this window to create, edit and manage features using menu commands, tools, and a pop-up menu. When data in a workspace is initially drawn, the entire area is visible. You can use tools such as Pan, Zoom, and Refresh to change the display of the survey area.

You can add additional Display windows by choosing the **New Window** command from the **Windows** menu. Multiple windows can be displayed in varying arrangements and there are pre-set options to tile horizontally or vertically and cascade the Display windows. These options are also accessible from the Windows menu. Each Display window can have unique settings in terms of the layers being displayed and the layer order. However, if you close a layer in one Display window, the layer will be removed from all Display windows.



- **Log Viewer** Displays the Records of the processes applied to the selected line(s), listed in the left-hand side column of this window, in chronological order, with the earliest applied process at the top of the list and the latest process applied at the bottom of the list. The column on the right side of this window, displays additional information for the process selected in the list. This information is listed by category and can be sorted alphabetically using the tool icon. These records are saved to a LogFile, automatically created in XML format in the folder for each line.

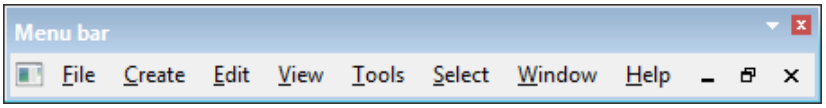
- **TPU Analysis Window** Displays the proportional effect of the various uncertainty sources that make up the TPU (Vertical and Horizontal), on the selected soundings in Swath or Subset Editors. These component sources are displayed in pie chart, bar chart or scatter plot graphs.

The Toolbars, like the windows can be customized to show the desired icons for each of the functions in HIPS and SIPS.

- **Toolbars** provide shortcuts to many of the menu commands. If you let the cursor hover (without clicking) over a toolbar icon, a tooltip (small pop-up text box) is displayed indicating the command that is performed if you click the icon. By default, only a subset of the entire tool icon set is displayed in the various toolbars. You can, however, choose which icons to show or hide, and you can create your own toolbars using the Customize command under the **View** > **Toolbars** menu.

- **Status bar** is displayed across the bottom of the main application window. The status bar displays the following: information about the operation currently taking place: Number of selected features, Projection of the current view, Scale of the current view and the Coordinates (**Ground** or **Geographic**) of the cursor position.

Finally, the Menus provide another way to access functions in HIPS and SIPS.



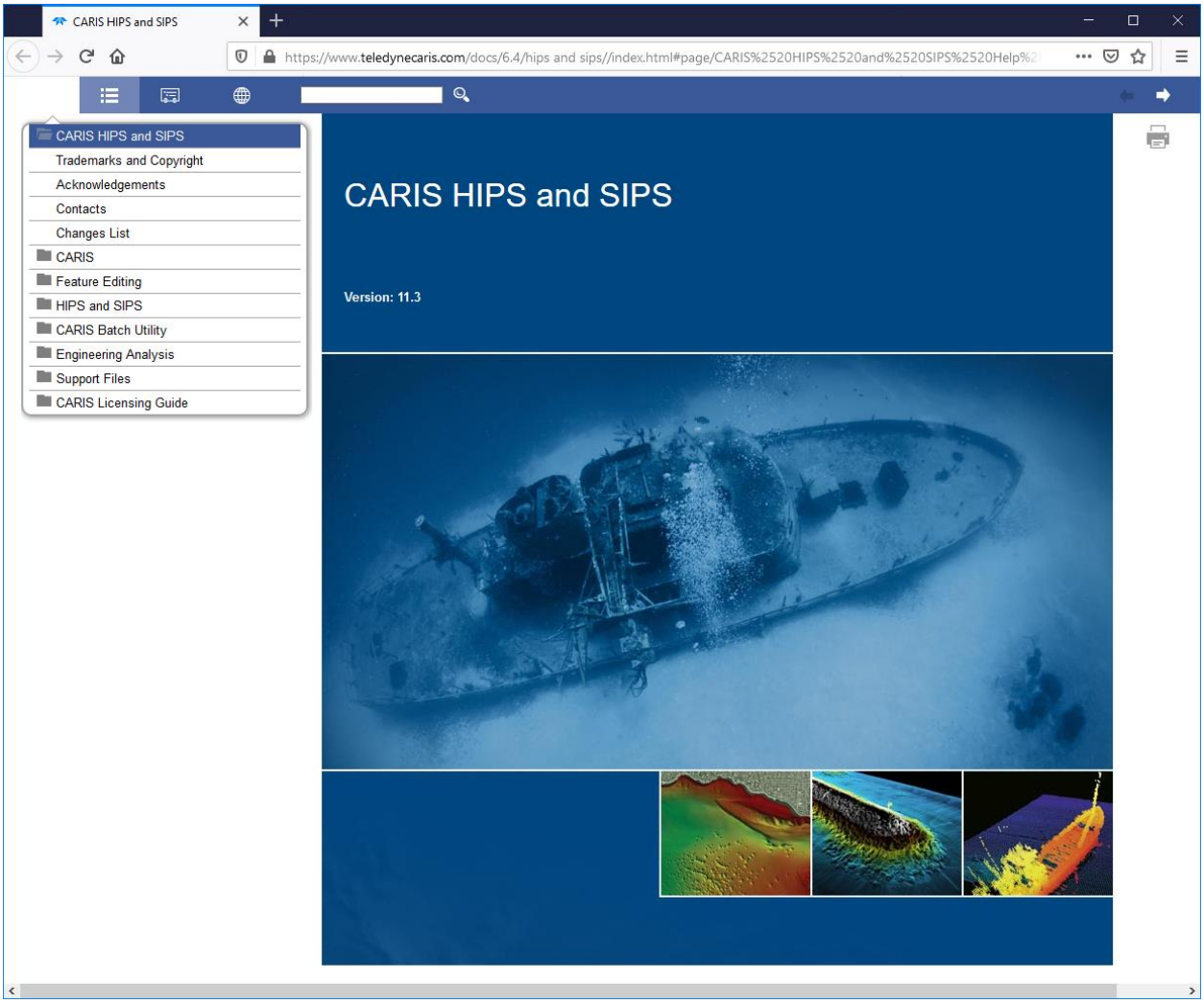
Menu functionality is presented in a simple, easy to follow structure. Many of the commands are also available as toolbar shortcuts. The following list summarizes some of the functionality available in the menus:

- **File:** functions to create Feature Layers, HIPS files and Subset tiles, Open files, projects, connections and services, close projects, save layers and projects, import and export data, print, recent files and projects, etc.
- **Create:** functions to create, filter, copy and repeat features, establish relationships, etc.
- **Edit:** functions to Undo, Redo, Restart Cleaning, modify spatial and attribute information of existing features, change object acronym/attribute values for a selection of features, etc.
- **View:** functions to Overview, Refresh, Pan, Zoom, Flicker, Swipe, 3D view, Open Windows and Toolbars, Rejected Flag Types, etc.
- **Tools:** functions to Measure Distance and Angle, Register, Run Process Model, 3D Flight Path, to open all Editors (Process Designer, Vessel, Sound Velocity Profile, Tide, Attitude, Navigation, Swath, Subset, Side Scan and Single Beam), Report, Automatic Boresight Calibration, HIPS and SIPS Processes (Filters, Compute Separation Model, SVC Kongsberg, Create HIPS Vessel File from Data, Georeference Bathymetry, Set Navigation Sources and Create Beam Pattern), Coverages (Bands, Modify, Compute Statistics, Bounding Polygon, Grid and QC Report), SIPS Mosaics, Profile, Features (Contours, Soundings, Vectorize Raster), Modules and Options.
- **Select:** functions to Select features using different types of selection methods, including selecting by filter (e.g., by feature object acronym, feature type, object ID), etc.
- **Window:** functions to move and arrange Windows and Layouts.
- **Help:** Launches the Help Topics window, Catalogue Browser, S-57 ENC Object Catalogue, Corporate Home Page, What's New! (past and future highlights), License Manager, Trademarks and Licensing, Changes lists and displays information about the current version (About CARIS).

Help Menu

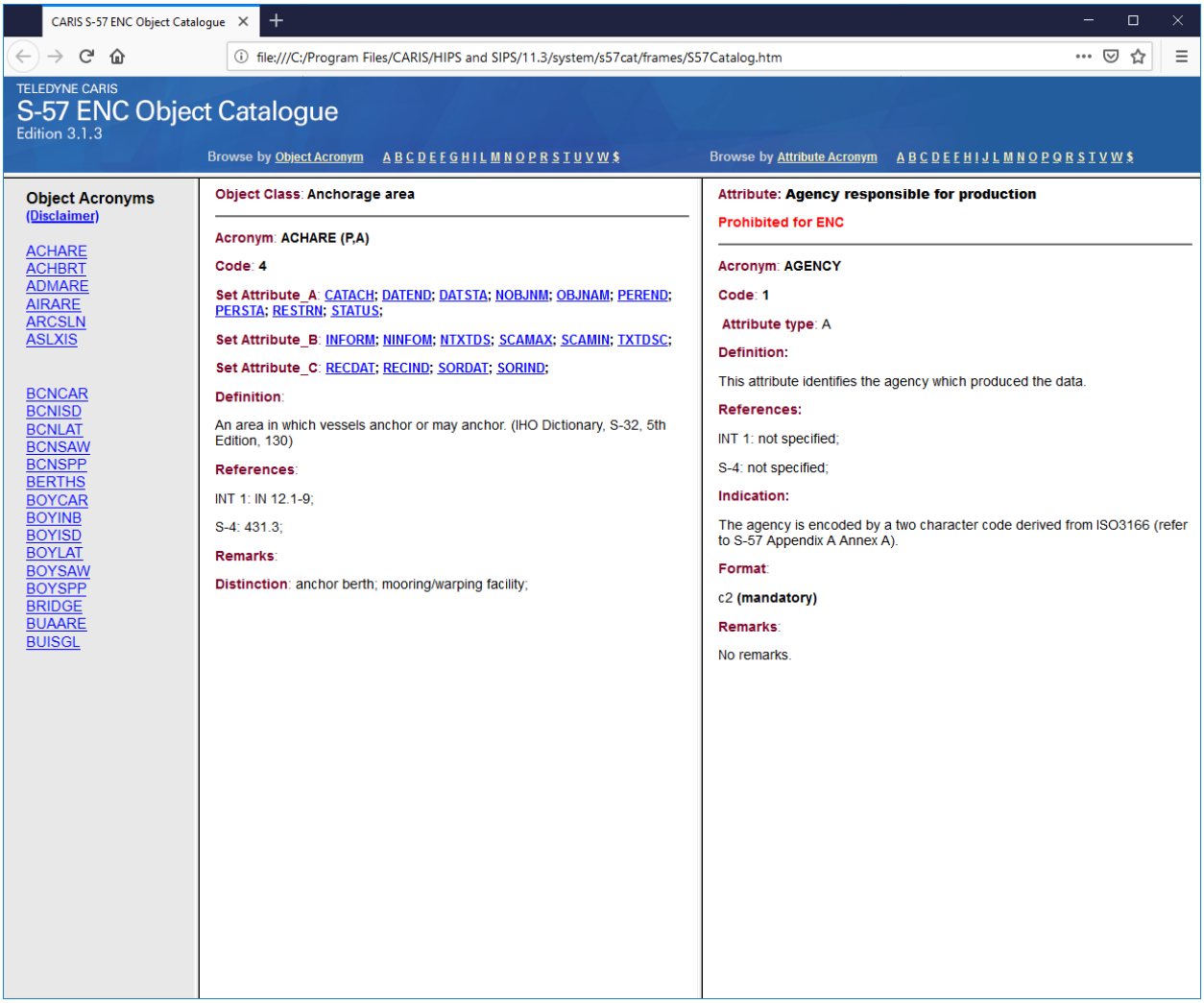
Help Topics

The **CARIS HIPS and SIPS Help Topics** can be accessed from the **Help** Menu and it will be displayed on the computer's default Internet browser.



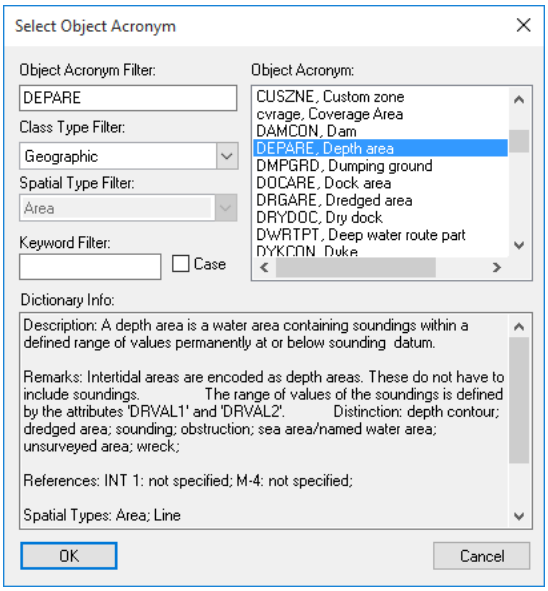
S-57 ENC Object Catalogue

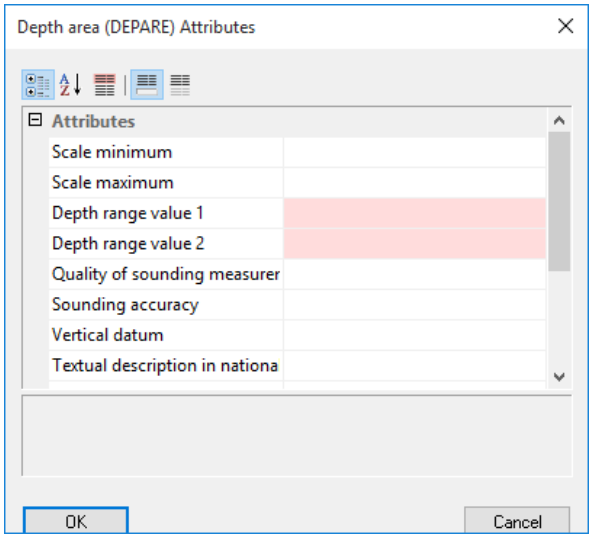
The **S-57 ENC Object Catalogue** can be started from the **Help** menu too. This is an HTML-format index of S-57 ENC Object and Attribute Class information. All vector data in HIPS and SIPS is based on the S-57 model, therefore this information is useful when trying to understand which object codes and attributes should be used when creating and editing features.



The **S-57 ENC Object Catalogue** opens in the computer's default Internet browser too, and can be used to obtain additional information about any:

- S-57 object class and definition
- S-57 attribute class and definition
- S-57 attribute value and explanation





When working with S-57 Features, you will also have access to the Object and Attribute Catalogue Browsers. These browsers allow you to search for specific objects or attributes by using keywords.

Corporate Home Page

Selecting this option, you will be pointed to our Corporate Home Page, where you can find latest news, access to our Online Customer Services, therefore accessing to our Products Downloads, Support, Licencing and Tech Notes, amongst others.

What's New!

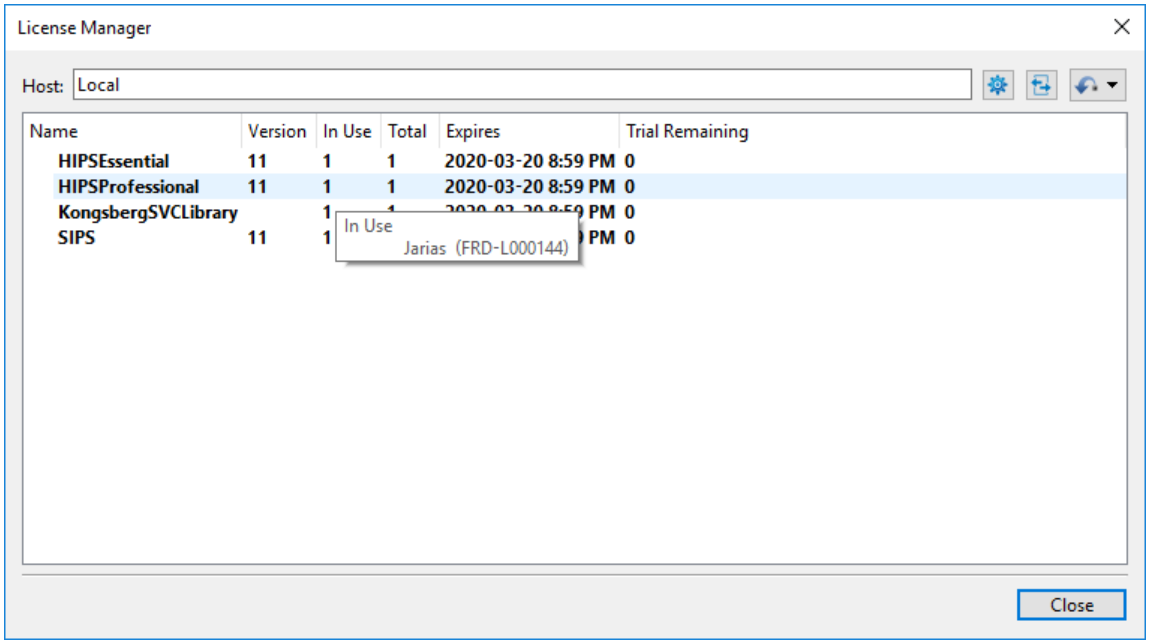
This option provides a link to a highlights page on the Teledyne CARIS web site. This page provides information about recent feature highlights in CARIS products. Once the page has been loaded, you can click on the link for each product to see the highlights specific to that product.

License Manager

The License Manager tool is used to view and manage the license associated with the installation of a Teledyne CARIS application.

The information provided in the License Manager includes the name of the computer housing the license in use ,the names of the modules included in the license, the versions of the modules, the number of work stations currently using the license, the number of seats available with the license (this will be 1 for a local license), the expiry date of the license and also the number of days remaining in the trial if a trial license is being used

When a network license is being used, the list of items available on the server may include items that are not available with the current license. In this situation, the items included in the current license will be displayed in bold.



Trademarks and Licensing

The Trademarks and Licensing command provides access to the Teledyne CARIS trademarks information, as well as the licensing information for the third-party libraries shipped with the application.

Changes List

This option provides a link to open the Changes list where all the Highlights, Enhancements, Improvements and Routine Issues were fixed, on the current and previous versions.

About CARIS

This gives additional information about current version of each of the modules and additional information about when that version was released.

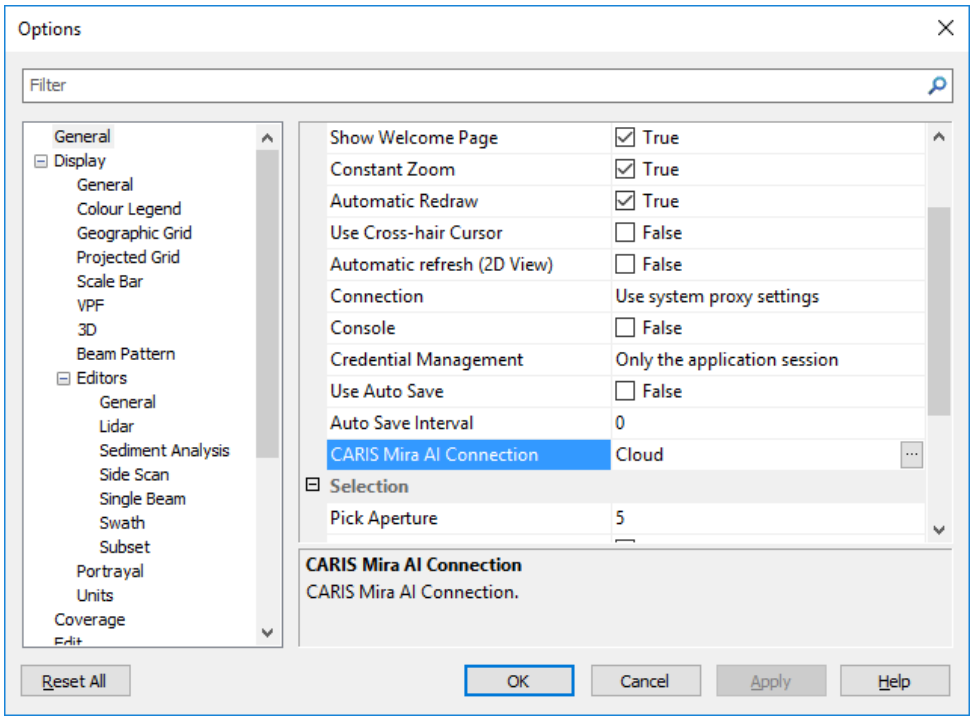
Tools > Options

The Options dialog box, controls how data is displayed, the behavior of some commands and the system environment.

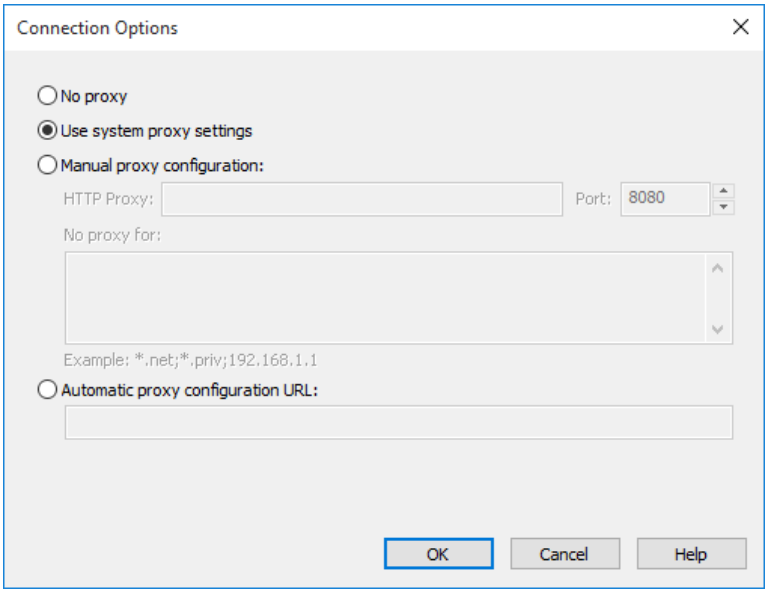
Exercise 7.

a. Select **Tools > Options** to display the **Options** dialog box.

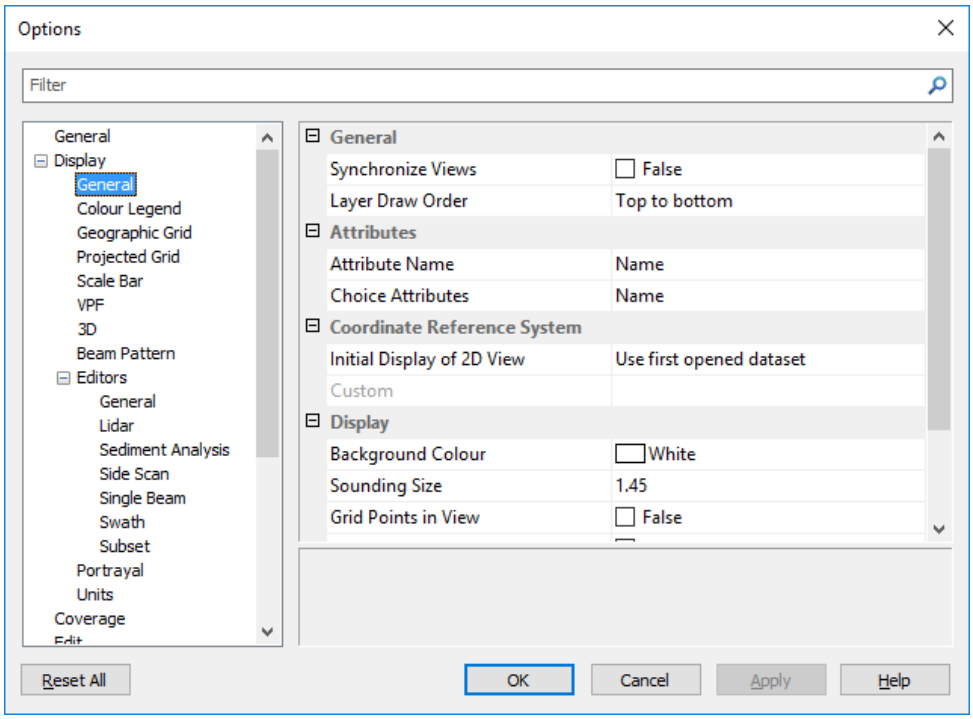
The Options dialog box contains settings relating to visualization of data, program settings and file locations. It is broken down in to the following categories: **General**, **Display, Coverage**, **Edit**, **Application Defaults**, and **File and Folders**.



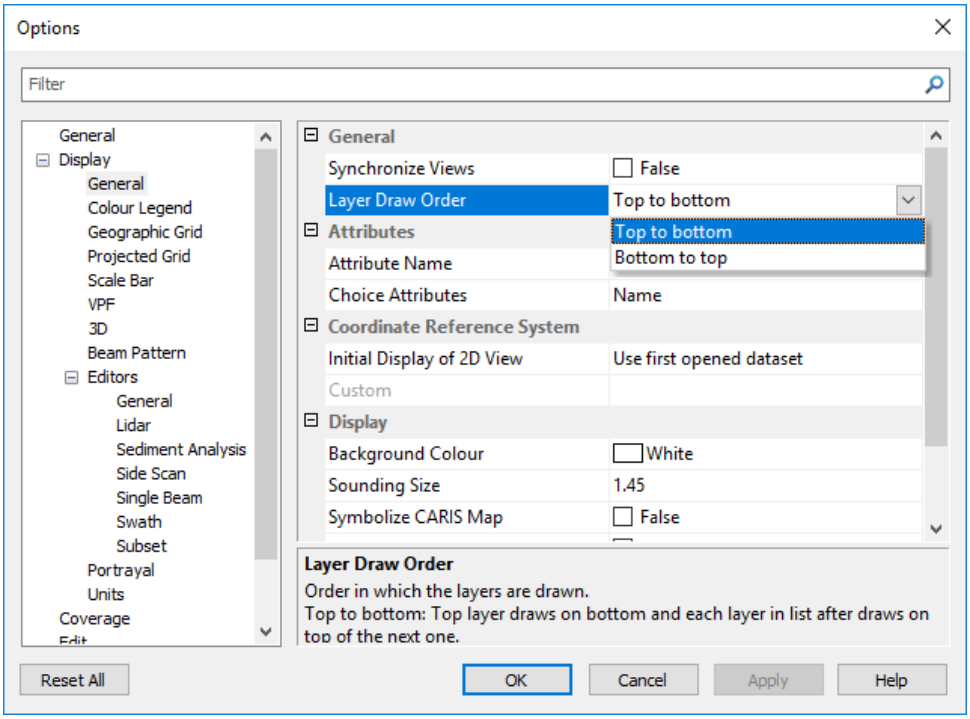
The **General** item controls the way you want to work with data in the Display window. On **CARIS Mira AI Connection**, the user can specify if he is connecting to a Cloud (managing credentials to access) or to a Network Server.



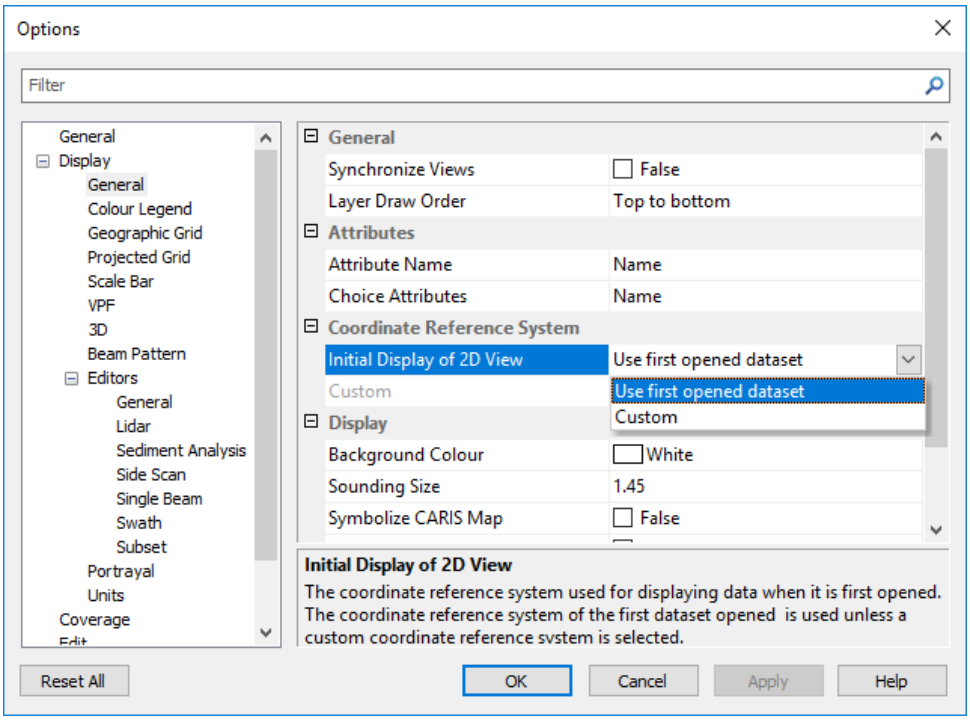
Also it contains the **Connection Options** which is used to define proxy settings to reach external URLs if the application is behind a firewall.



The **Display** Item controls additional parameters, which change the appearance of data in **General**, **Colour Legend**, **Geographic Grid**, **Projected Grid**, **Scale Bar**, **VPF**, **3D**, **Beam Pattern**, **Editors**, **Portrayal** and **Units.**



On **Display > General** the draw order can be changed. **Top to bottom** is the default value, showing in front the first object on Layers Window. Can be selected the Inverse too (**Bottom to top**)

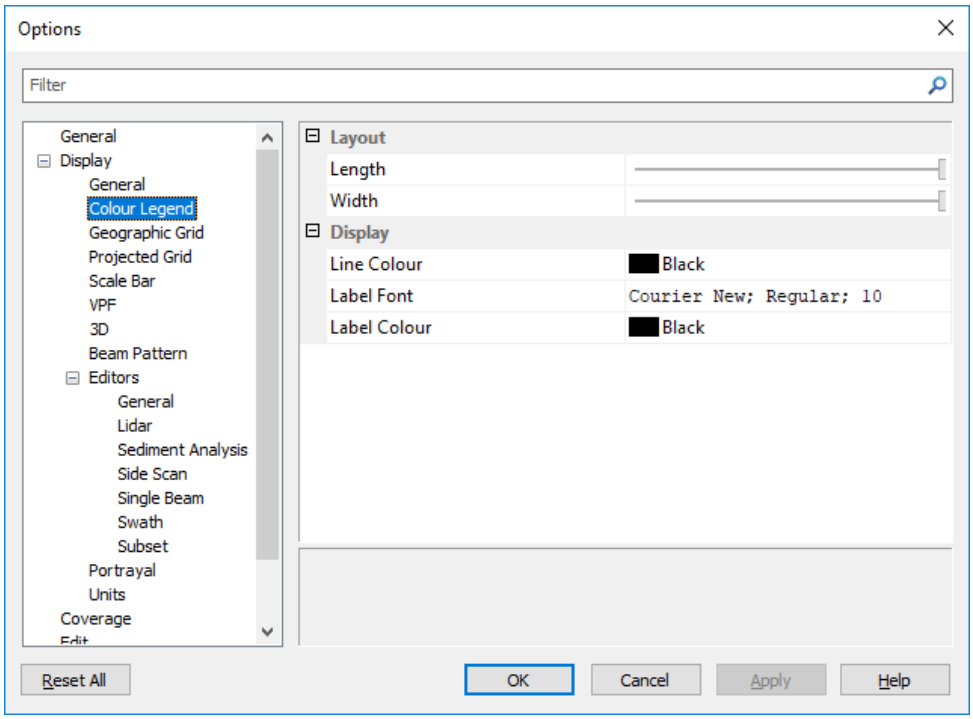


Also controls the **Initial Display** category can change the coordinate reference system that will be used for the initial display of data each time the application is started. There are two options:

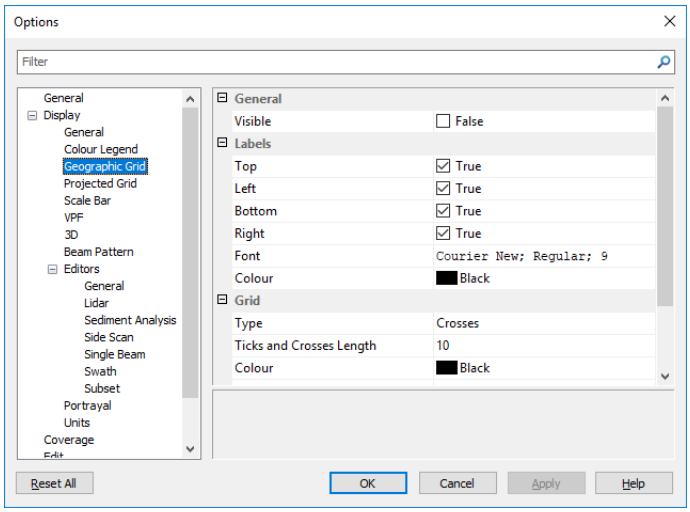
- **Use first opened dataset**: This option will cause the application to automatically use the coordinate reference system of the first dataset opened. If the first dataset opened does not have a coordinate reference system, you will be prompted to select one. The selected coordinate reference system then becomes the default for all other datasets opened in the session.

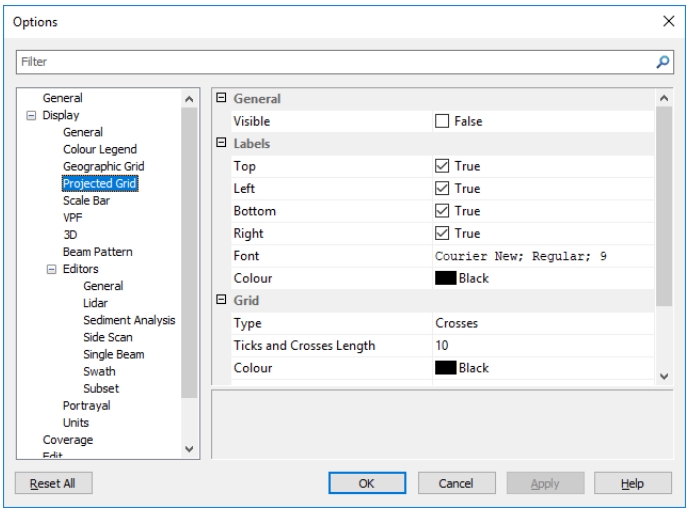
- **Custom**: This option allows you to select the **Coordinate Reference System** that will be used to display all datasets, regardless of the projections of the datasets opened. Click the Browse button (**...**) to launch the **Select Coordinate Reference System** dialog box.

Also it contains some additional **Display** options as **Background Color**, **Sounding Size**, etc.

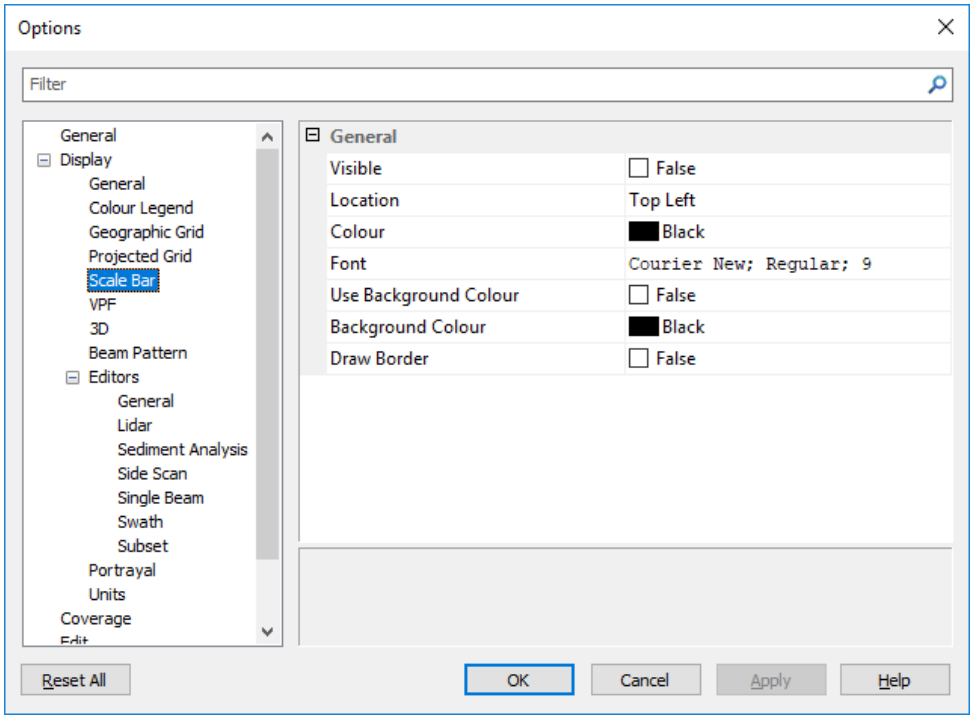


The **Colour Legend** item, controls the appearance of the legend that can be optionally applied for surface layers. You can turn the legend on through the Properties window.

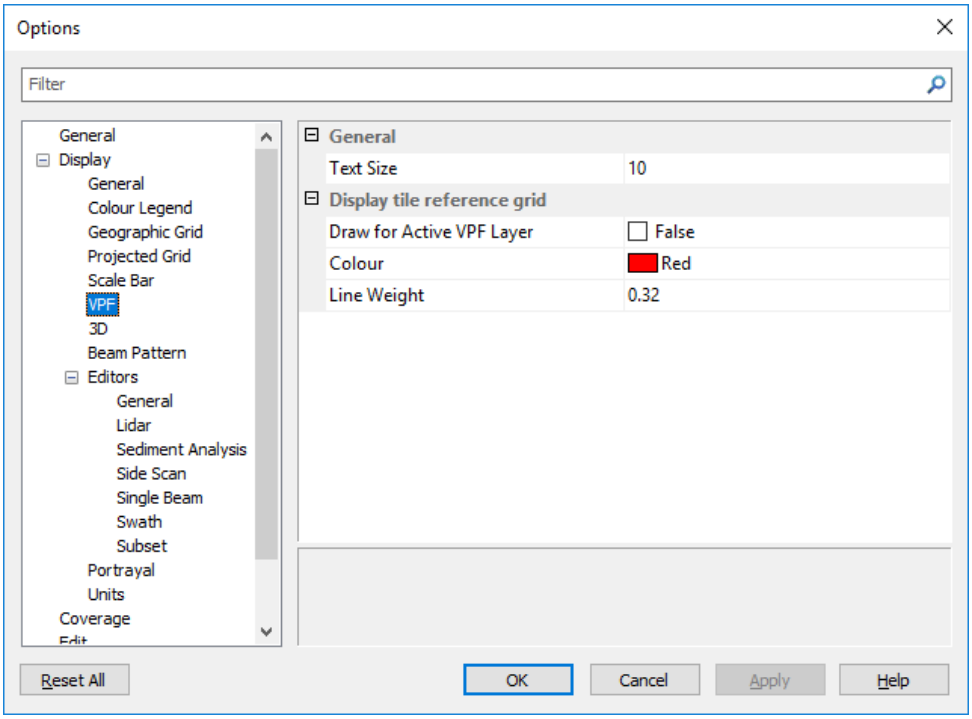




The display properties of both the **Geographic** and **Projected Grids** can be edited to make visible ticks or crosses for each one.

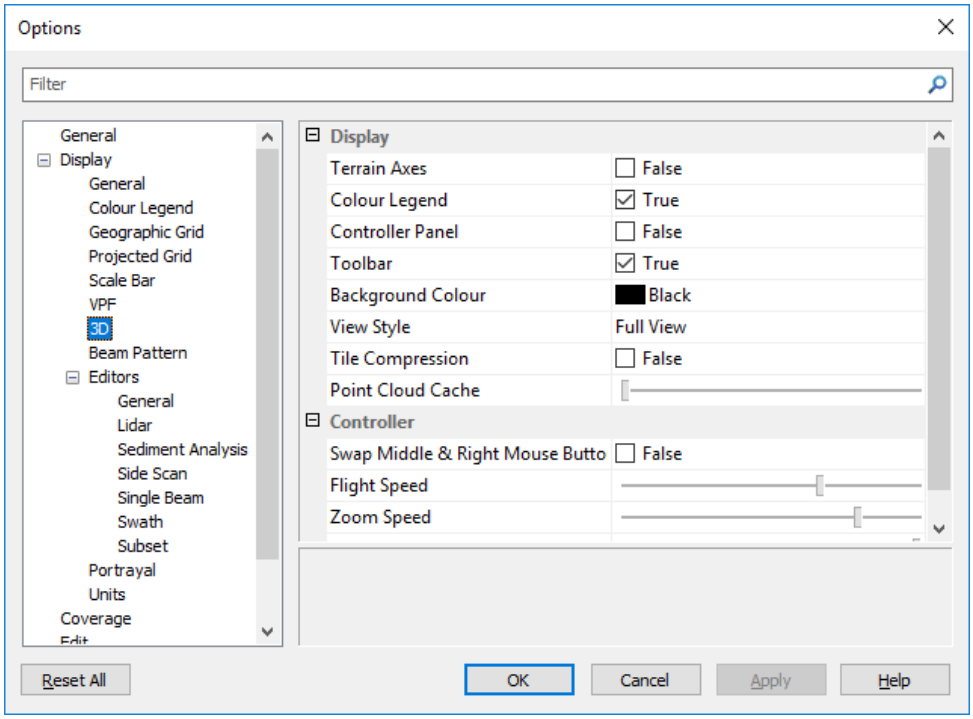


If you would like to display a **Scale Bar**, set Visible to **True** and it will appear in the desired **Location** of the Display window.

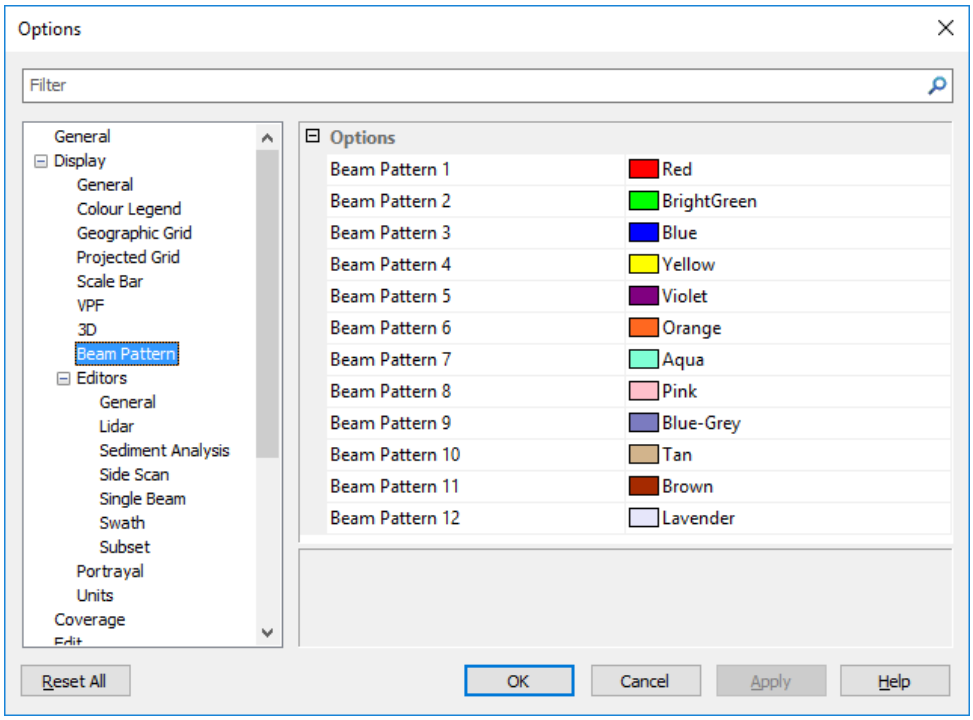


VPF is used to define display settings for VPF (Vector Product Format) data. The following options are available:

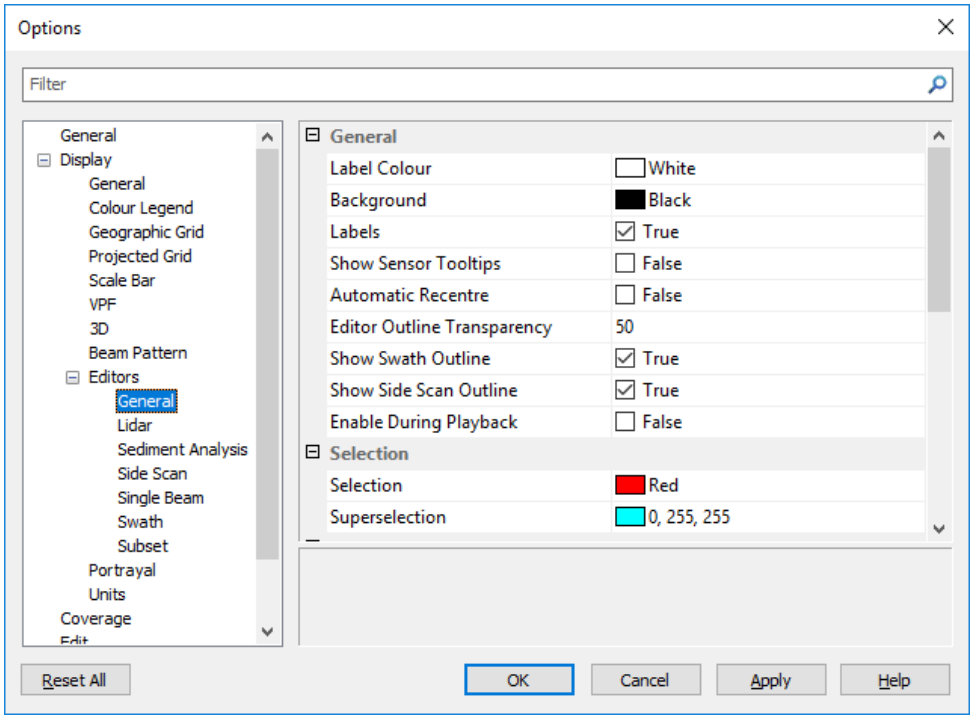
- **Text size**: The size at which all text will be displayed in a VPF file.
- **Draw for active VPF layer**: Displays tile reference grid.
  - **Colour**: The colour of the reference grid lines.
  - **Line weight**: The thickness of the reference grid lines in millimeters.



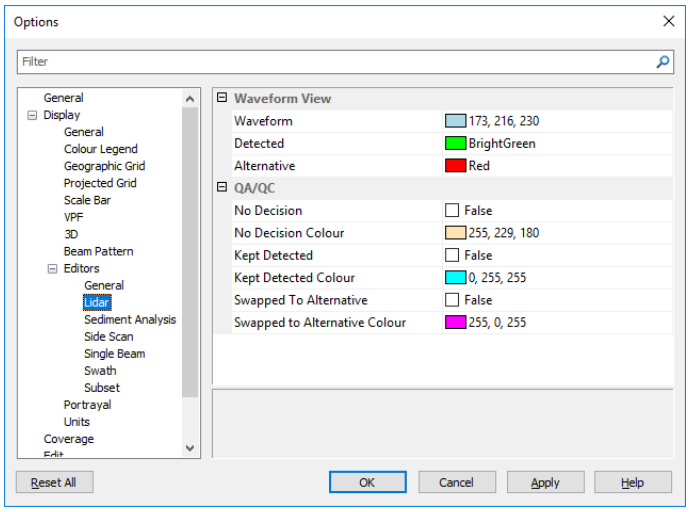
The **3D** item provides options for adjusting the settings of the keyboard and mouse controllers used when navigating on the **3D View**.

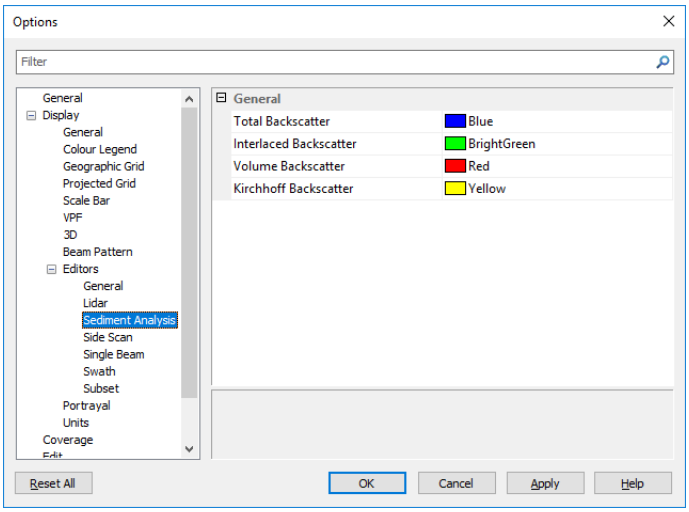


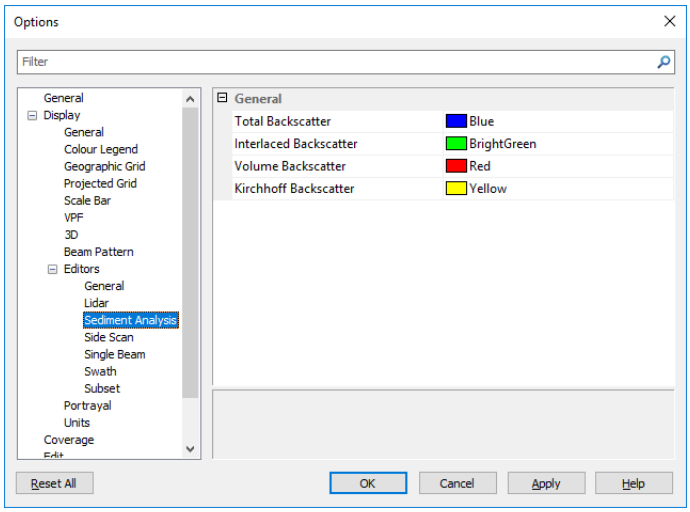
The **Beam Pattern** item establish the default colours for Multilple Bottom Detections.

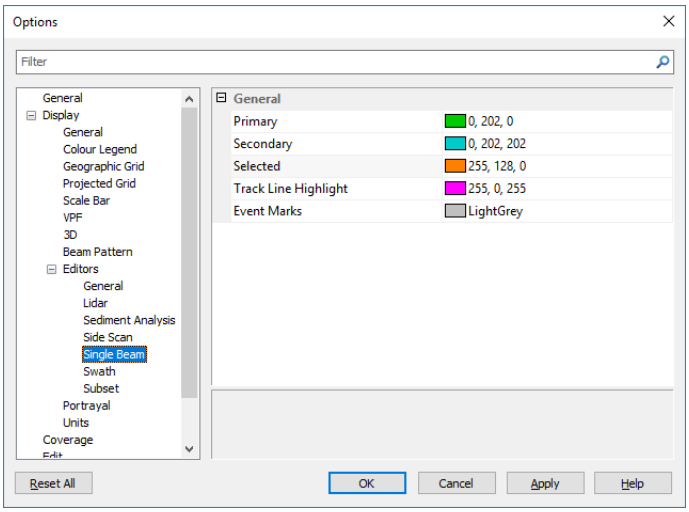


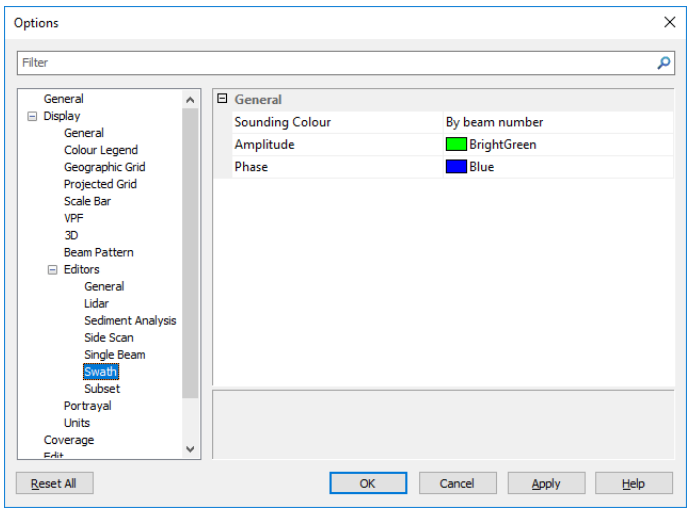
The **Editors > General** Item is used to change the colours of **Label**, **Background**, status of **selection** and **status** of points in the Subset Editor.

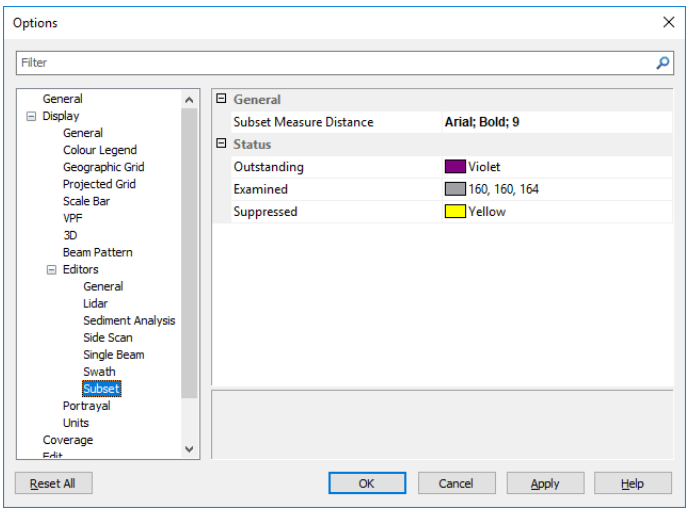




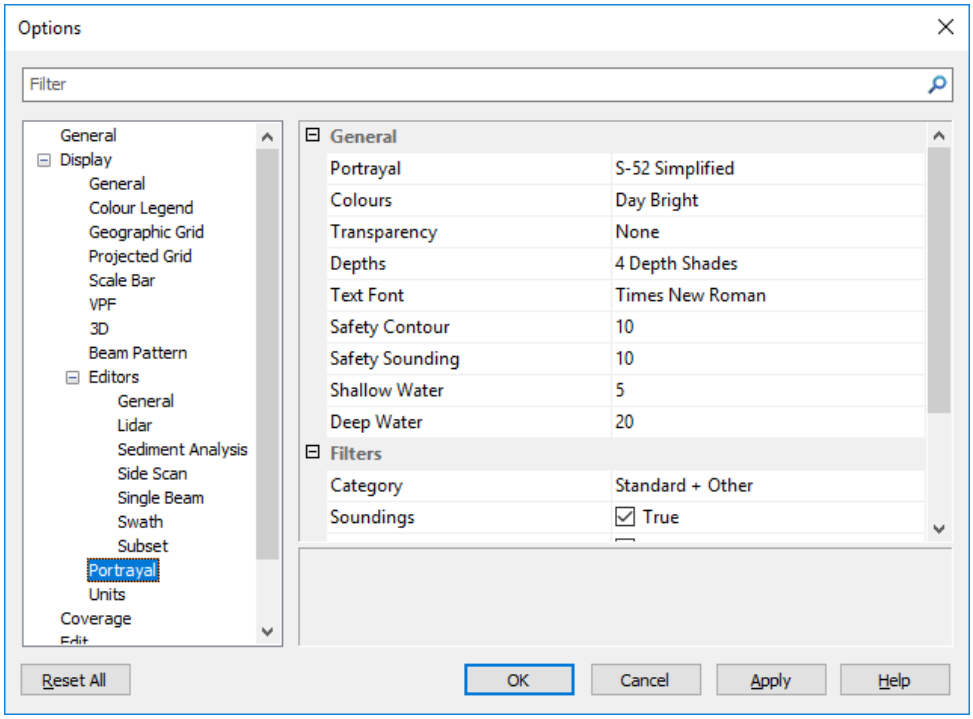




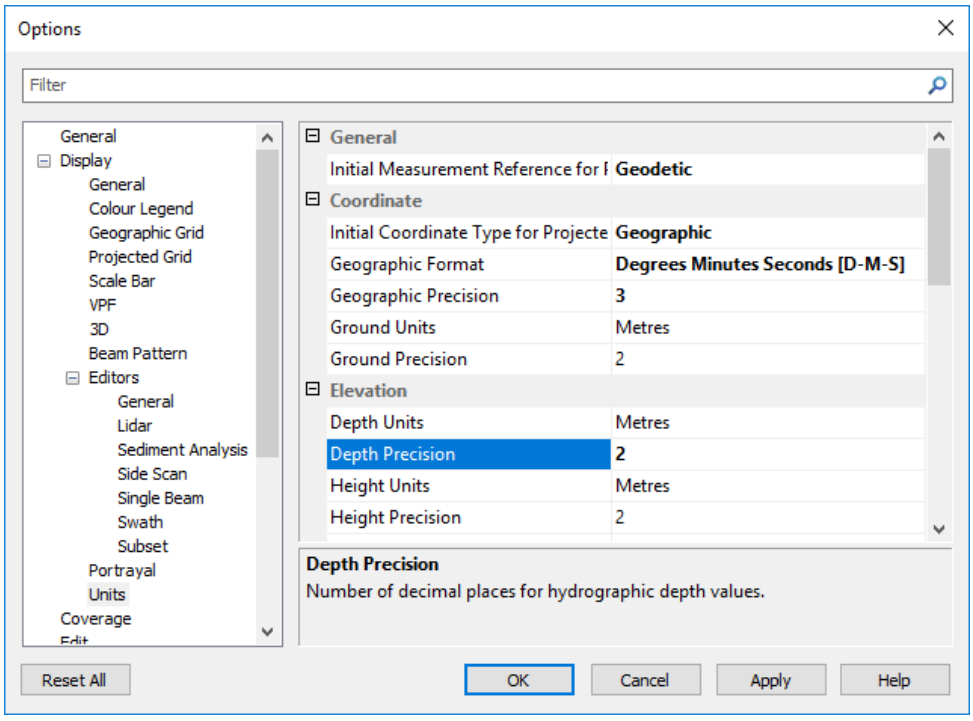




Include also Colour options for these Editors: **Lidar**, **Sediment Analysis**, **Side Scan**, **Single Beam**, **Swath** and **Subset**



The **Portrayal** item controls the appearance of **S-57 data** used as background data.



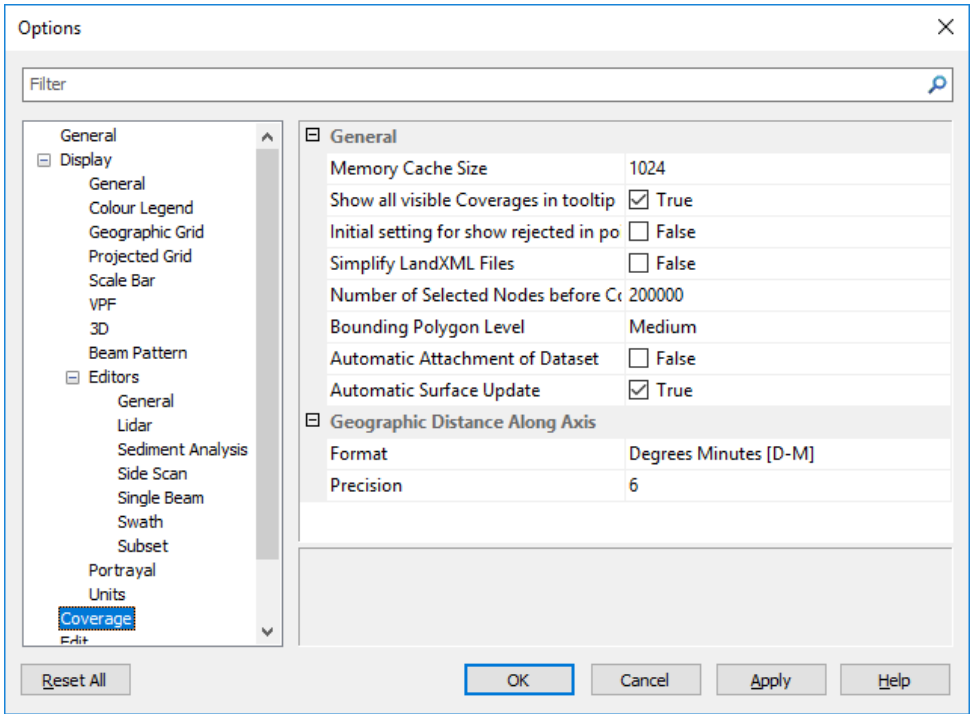
The Display > Units item lets you define the selection of **Units** for showing **Position**, **Elevation** (Depth) with **Sounding Rounding** rules, **Angle**, **Area**, **Volume**, **Distance**, **Speed** and **Sound Speed**.

b. In **Display > Units** tab, select **Initial Measurement Reference for projected Display**, as **Geodetic**.

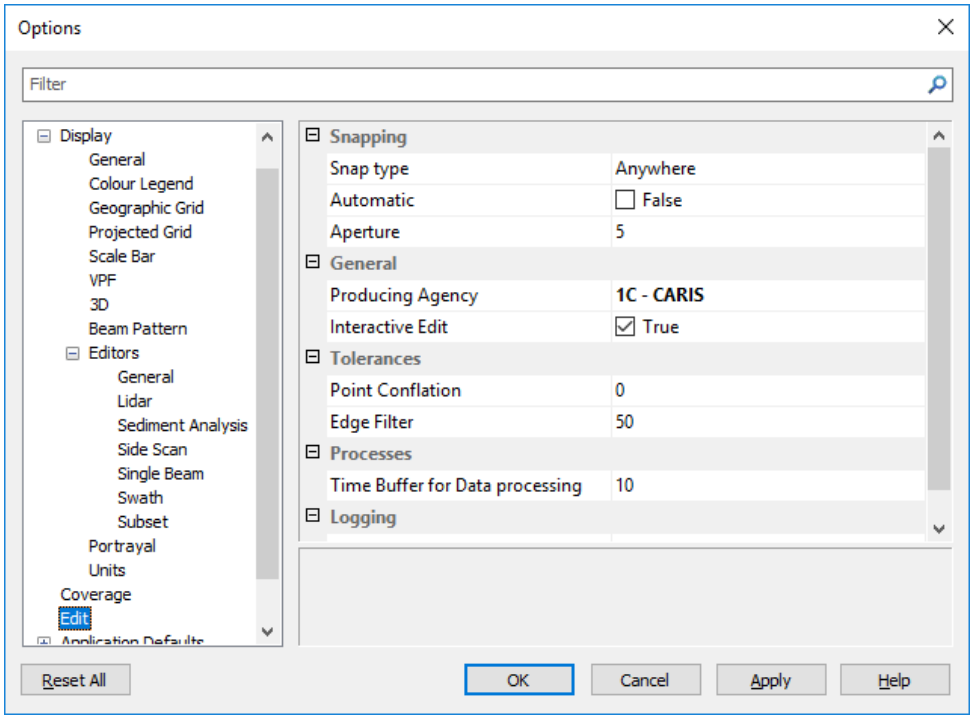
c. On **Initial Coordinate Type for Projected Display**, select **Geographic**.

d. Select **Geographic** as the Coordinate type, **Degrees Minutes Seconds [D-M-S]** as the Geographic Format and **3** as the Geographic Precision.

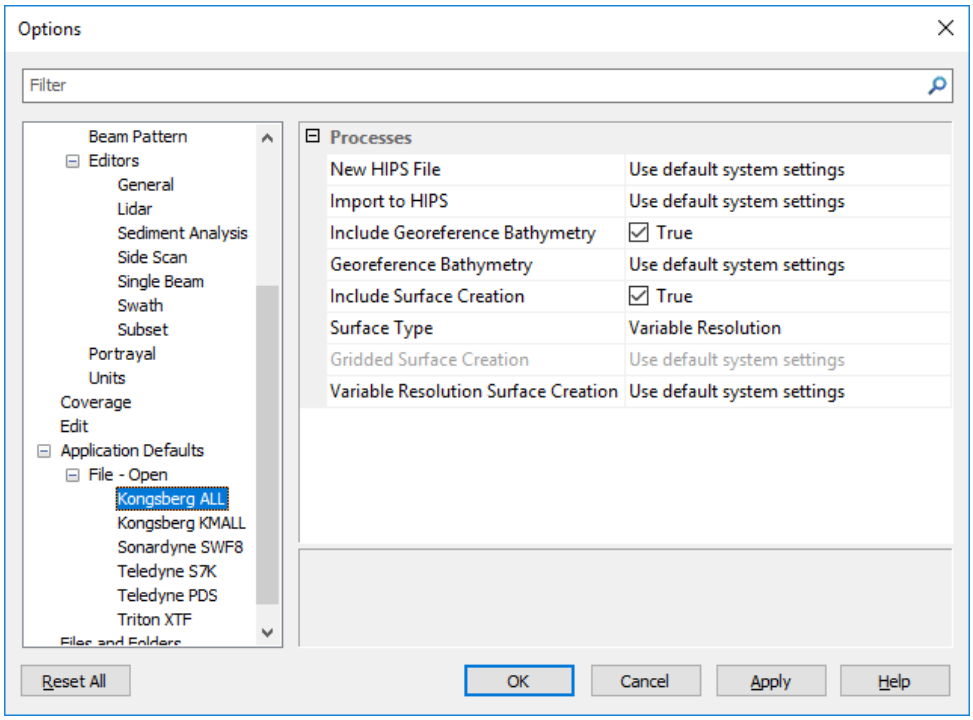
e. Leave **Meters** as the **Depth Units** and **2** as **Depth Precision**, leave all other settings as default.



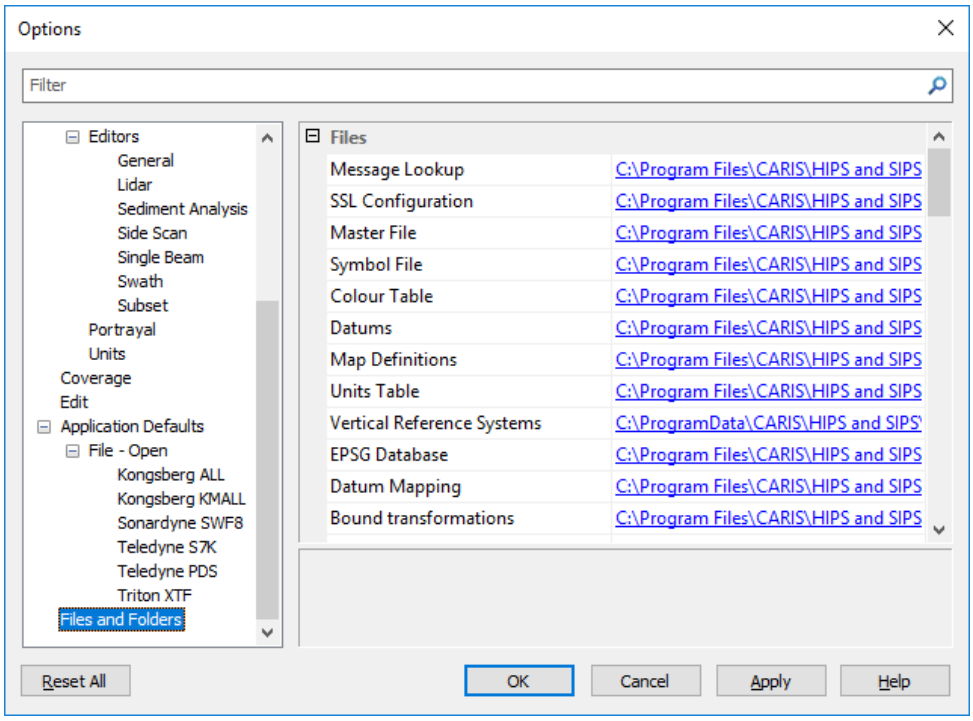
The **Coverage** item, allows you to define the limit of Memory Cache, if all surfaces will be visible in Tooltip, Show Rejected soundings in point cloud surfaces, Maximum Number of points in a TIN model and maximum selected nodes allowed before asking to continue, Type of Bounding Polygon and if the surfaces will be updated automatically.



The **Edit** item defines the Snapping, Producing Agency, Tolerances for Edit Data. Time Buffer for Data Processing will check pulls in adjacent records from the end or beginning of adjacent lines when logging is abruptly switched to a new file, which would otherwise result in data loss. Default value is 10 s.

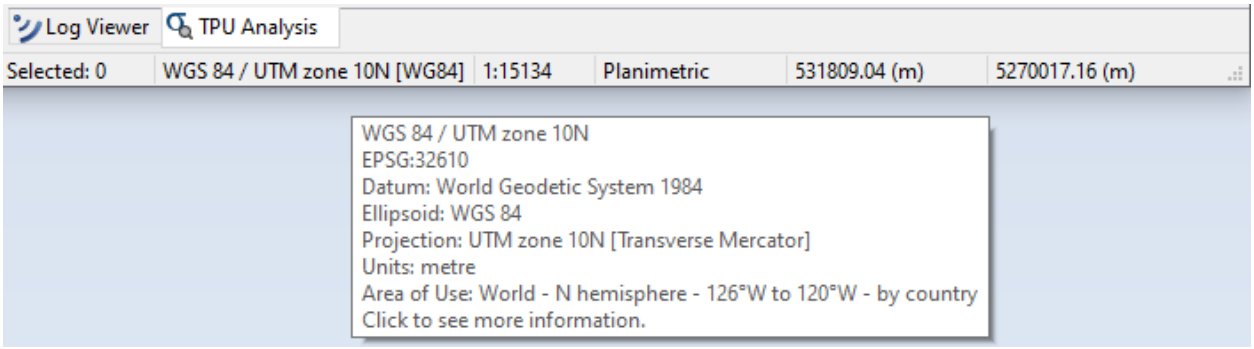


The Application Defaults, allows you to configure what options will be used each time a line or group of lines, will dragged and dropped or opened directly on the software. This includes; **New HIPS File**, **Import to HIPS**, **Include Georeference Bathymetry**, **Georeference Bathymetry**, **Include Surface Creation**, **Surface Type** and **Gridded Surface Creation**, or **Variable Resolution Surface Creation**, options.

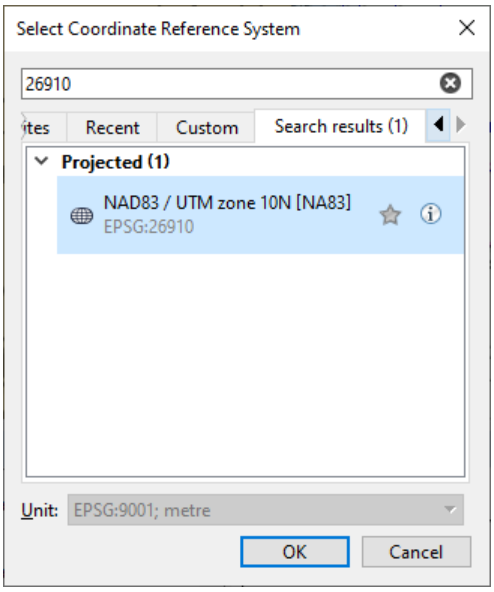


The **Files and Folders** displays the environment variables with associated paths for system files and configuration files used for color maps, feature codes, etc. Most files are in **…\CARIS\HIPS and SIPS\<version>\System\...** folder by default.

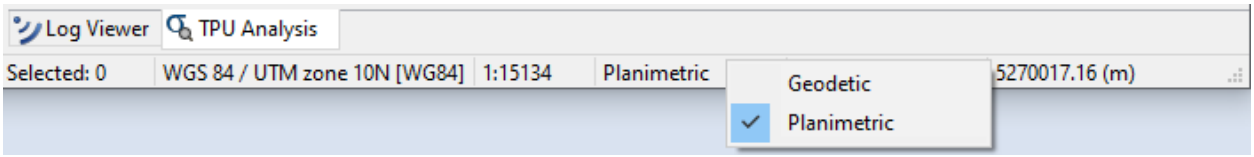
f. Click **Apply** and **OK** to save any changes made in the Options



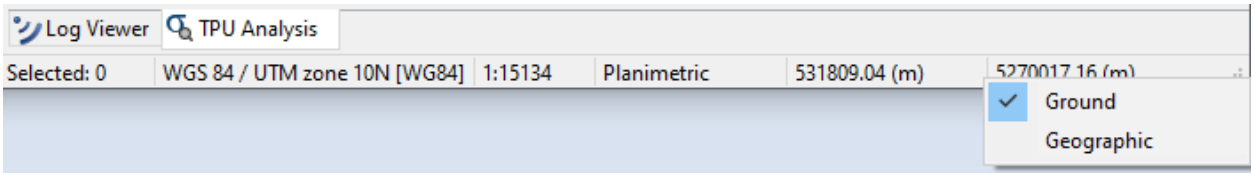
g. Left click on the Status Bar to see the options to change **Coordinate Reference System**.



h. On the pop up window type **26910** and select the **CRS NAD83 / UTM zone 10N [NA83] EPSG:26910**. Click OK.



i. Left click on the Status Bar to see the options to toggle between **Geodetic** and **Planimetric** Options.



j. Left click on the Status Bar to see the options to toggle between **Ground** and **Geographic** Options.

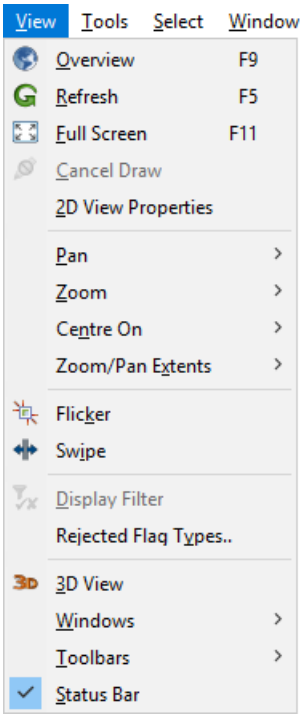
Panning and Zooming

These tools enable you to move around the screen and to zoom in and out. To use the multi-use tool, the option **Enable Constant Zoom** must be checked in **Tools > Options > General**

By default, the single use tools can be found on the Standard toolbar.

Tip: If the mouse has a roller wheel for the middle button, then a roll forward will zoom in and a roll back will zoom out. This is a dynamic zooming function with the use of this roller. The scroll wheel will zoom in on the area the mouse is located. In addition, if you click the middle button of the mouse it will refresh the screen. For Panning around some specific area, you need to press the middle button of the mouse, hold it and then release it on the desired location.

The Pan Tool is enable by default, if you need to change to another tool (like Zoom or Refresh) you can select them from the toolbar or using the Function or Control + Function Keys:



You can zoom to the extents of one of the objects on the **Layers** window, by right-clicking on the object and select the **Zoom to Extents** option.

Exercise 8.

a. Click the **Overview** icon, press **F9** key, or right-click the main display and click the **Overview** option from the dropdown menu.

b. On the **Layers** window, right-click **US5WA14M** layer and click **Zoom to Extents** option from the dropdown menu. It will zoom the extents of ENC.

c. On the **Layers** window, right-click **Hypack <Date> <Time> Track Lines** layer and click **Zoom to Extents** option from the dropdown menu. It will zoom only to the extents of the project.

You can also see the main display in Full Screen Presentation.

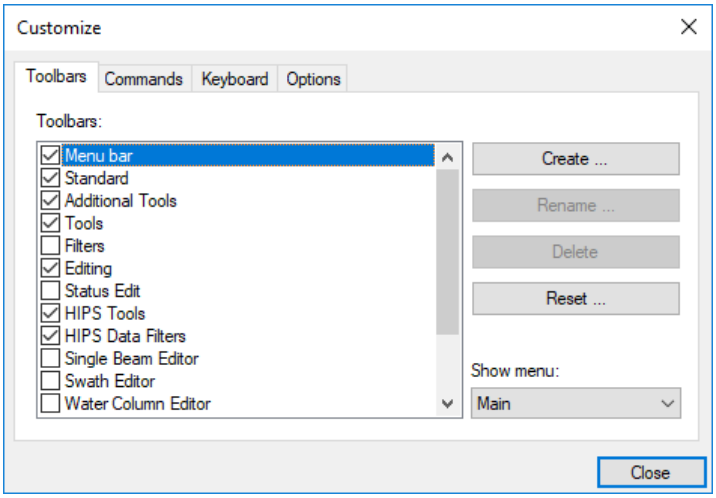
d. Go to the menu **View > Full Screen**, or press **F11** key.

e. Press **F11** key, once again to return to the original presentation.

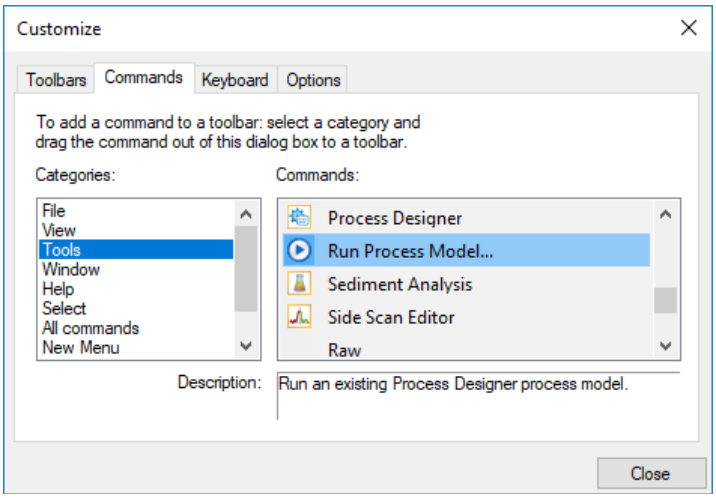
Toolbars and Shortcut Keys

All toolbars, menu bars, editor and information windows can be docked or undocked from their default location. They can be moved anywhere on the screen. If they are moved with the <Ctrl> key pressed they will not re-dock. The undocking properties are very useful when a dual monitor system is used.

On **View** > **Toolbars** menu, you can choose which toolbars you would like to have on the main toolbars.



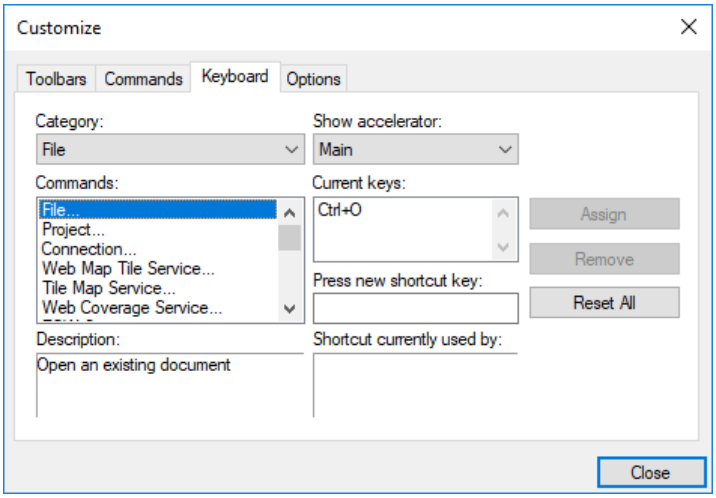
Also if you click the **Customize…** option from the bottom of the Toolbars list, there will be an option to add a New Toolbar (**Create…**).



Under the **Commands** tab all the existing tool icons and menu items are displayed. New icons can be added by dragging the icons from the "Commands:" list to an existing (or new) toolbar.

Exercise 9.

a. Under **Commands** tab select the Category **Tools** and search for the **Run Process Model…** command. Drag it and drop it on the **HIPS Tools** toolbar.

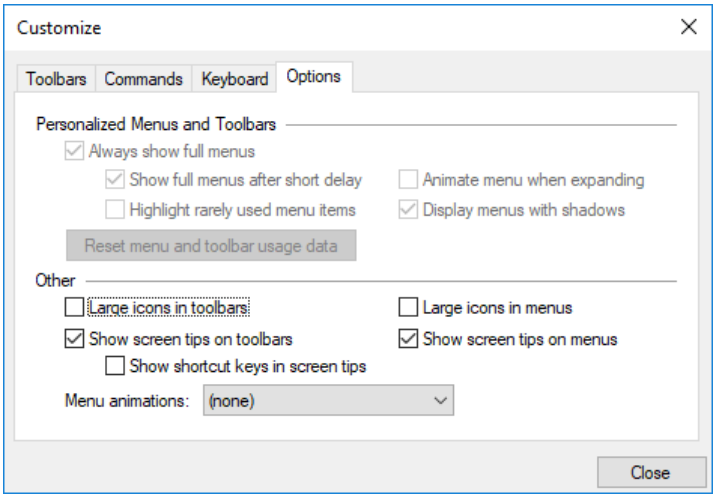


The **Keyboard** tab, lists all available menu items. Click a menu item in the list to see if it has an existing shortcut key. If it does, you can replace the existing shortcut, or you can create a second one. When you enter a key or combination of keys, the dialog box warns if that keyboard assignment is already being used.

By default, **Next Line** and **Previous Line** can be applied from the Select toolbar and Select menu only. If you want to use **<Shift>+N** and **<Shift>+P** as shortcuts, this can be set up in the Shortcut Keys dialog box.

Once you have created your shortcut key, you can use it during processing of the data. Other possible processes for which to create shortcut keys are: (Under Category: Process)

- Georeference Bathymetry
- Separation Model
- Create HIPS Vessel from Data



The **Options** tab shows the options you want to apply to the toolbars. The following is a list of display options available for your customizations

Personalized Menus and Toolbars (all disabled by default):
Always show full menus: all menu items for selected menus are always displayed. Sub-options related to this option:

- **Show full menus after short delay**
- **Animate menu when expanding**
- **Highlight rarely used menu items**
- **Display menus with shadows**

To clear usage data for all toolbar and menu items, click the **Reset menu and toolbar usage data** option.

Other
These options are enabled by default and apply to all menus and toolbars (default and customized). The following is the list of available options:

- **Large icons in toolbars**
- **Large icons in menus**
- **Show screen tips on toolbars**
- **Show shortcut keys in screen tips**

- **Show screen tips on menus**
- **Menu animations**: click an animation to use for displaying menus (only applies to items in the top level of the menu).

S-57 Display, Query, filter

S-57 data can be manipulated using the S-52 Display settings, as you saw in **Tools** > **Options** > **Portrayal**.

These options can be used to modify how the objects within the ENC are displayed. The following settings can be modified:

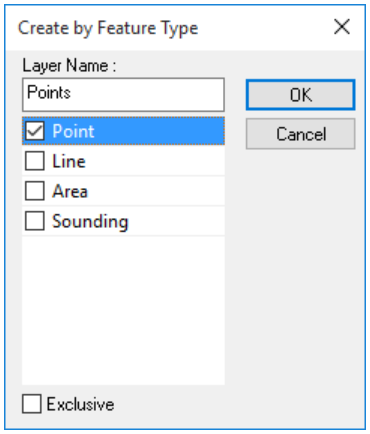
- Colours
- Depth shades
- Safety contours, Safety depths
- Display categories
- Sounding and Meta Object and Text switches

The objects within the ENC can be queried or filtered to a separate layer.

Exercise 10.

a. Click the **18474_1** Layer check box to disable the raster chart. **Refresh** the screen.

b. Select **US5WA14M** layer on the **Layers** window, right-click and select **Add Layer(s) > Feature Type…** which opens a dialog box.



c. Type **Points** for Layer Name and enable **Point** checkbox then click **OK**.

You'll see the new Points layer on the **Layers** window.

d. Disable the layer **US5WA14M**

e. **Refresh** the screen and only Point objects will be displayed.

f. Right-click on the **Points** layer and select **Remove Layer** form the drop list.

g. Turn on the layers **US5WA14M**.and **18474_1**. **Refresh** the screen.

Selecting Data

All vector and raster data can be selected by highlighting it on the **Layers** window, then by clicking on the objects in the Display window. Multiple objects, nodes and soundings can be selected using the **<Shift>** and **<Ctrl>** keys. Multiple objects, nodes and soundings can also be selected by dragging a selection box over the lines in the Display window.

Selection in the Display window can be done in three ways: **Select by Range**, **Select by Circle**, or **Select by Lasso.**

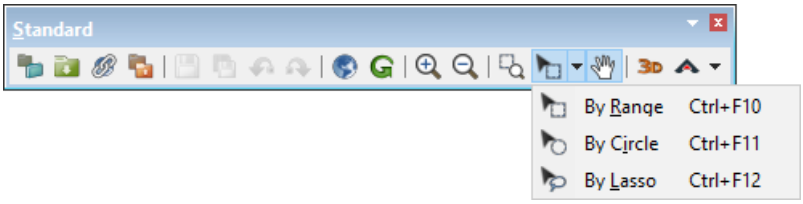
Lines cannot be selected when the cursor is in constant zoom mode. When in constant zoom mode, the cursor will appear as a magnifying glass and the zoom icon will be depressed in the toolbar. To exit from zoom mode, click the zoom icon or use the **ESC** key.

Other selection options are **All in Display**, **All** and **Clear Selection**.

Note: If you are unable to select lines in the Display window check to see that **Select by Range** tool is selected.

Exercise 11.

a. Select by line name within **Active Track Lines** window, select one or more lines while holding **<Ctrl>**.



b. Highlight **All Track Lines** on Layers window and with the **Select by Range** icon enabled (**Ctrl + F10**); make a selection within the display window.

c. Highlight **US5WA14M** Layer on **Layers** window and with the **Select by Range** icon enabled; select some objects within the display window.

d. For S-57 Objects, the Attributes window will populate with the Object Acronym and the proper Attributes. Attribute Name or Description (or both at the same time) can be changed on **Tools > Options > Display > General > Attributes…**

e. To Clear the Selection, you can use the menu **Select > Clear Selection** (**Ctrl + Shift + C**)

Query Lines

All the information listed when a line is queried is displayed on the **Selection** window. The columns can be sorted by clicking on any of the headings (organizing in ascending or descending order). By right-clicking on the headings and selecting **More…** from the pop-up menu you can choose which fields you would like to be displayed and also the order of them (in columns).

Making a right-click on the Selection window presents you with the options**: Centre On, Remove Subselection, Remove Others, Copy Cell, Copy Column, Copy Rows, Clear Selection, Delete and Zoom to (Selection and Superselection).** .If you select all rows (using **Shift** key) and select the option **Copy Rows** (making right click on **Selection** window), the contents of the Selection window, those can be taken into software such as Excel or Notepad.

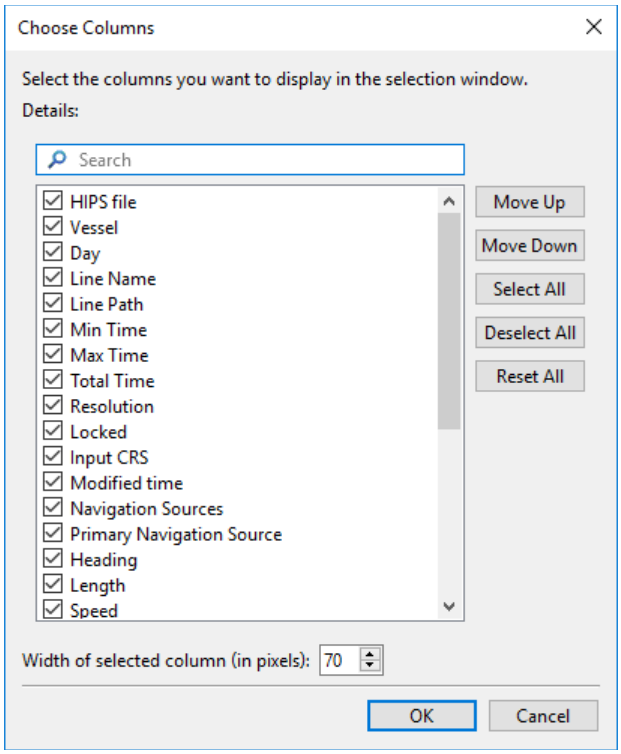
Right-click in the Display window to bring up a pop-up menu you can use to copy the geographic coordinates of the cursor position to the clipboard with the function **Copy Position**.

Exercise 12.

a. Select line **2011M_0901903** on **Active Track Lines** window.

b. Click the **Selection** window to view detailed information about the line.

c. Right-click the top title row of the table, then click **More…** to open a dialog box, where you can set which attributes are displayed when queried. Once finished click **OK**.



d. Within the Selection window right-click and choose **Copy**, to save all queried information in memory.

e. On a Text Editor, **Paste** the report of the queried line.

Save Project

A project file allows you to capture all the data sources and their properties that are currently open. This file remembers all the data you have open (metadata, survey lines, etc.) and consists of a series of data objects in XML format describing:

- **Workspace** – Creator of the session, HIPS project name, creation and last modification times, and location of the HIPS source data
- **View Extent** – The last used window size and location
- **Project Data** – Survey lines, CARIS files and background images

The Project (*.project) file replaces the previous CARIS Session (*.wrk files). Eventually these project files will be the same across all CARIS software packages.

You must still have a background file or dataset open as a geographic reference before you can create a project file.

Exercise 13.

a. Save the project by selecting **File > Save > Save Project As…** call the project **CUBE_DnDrop** under the folder **C:\Training\HIPS\Projects** and click **Save**.

Projects should be used to efficiently organize the data that you are working with. Having a series of small work areas as separate projects instead of one large project will allow for faster, more effective data access.

In addition, the Project can add **Sources from Project**, allowing you to add sources from a saved project in to the current one. Once the current project is opened, the files referenced by the saved project file open and the display properties from that saved project file, are applied to the current opened files.

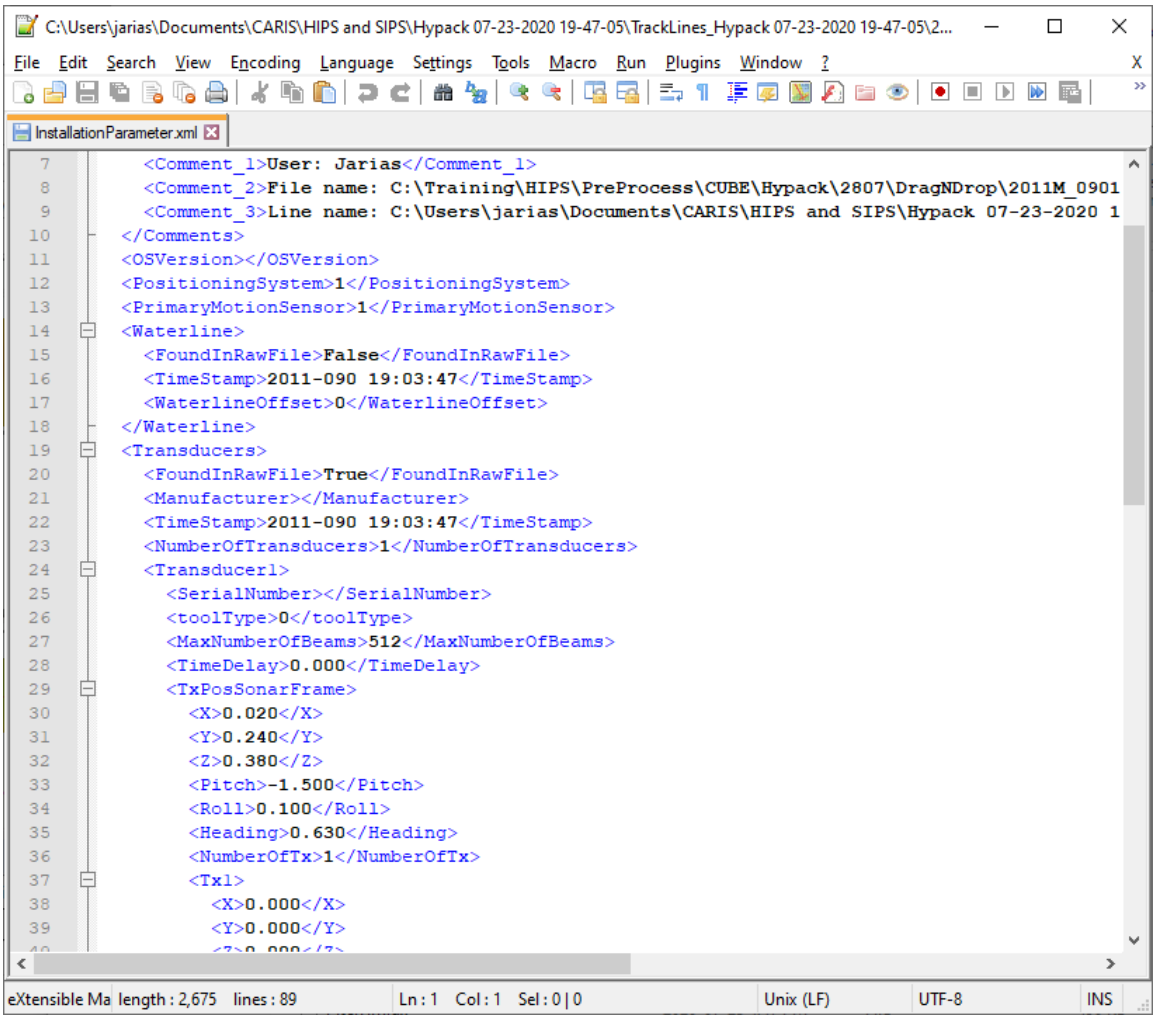
Vessel and HIPS Files

In HIPS and SIPS, you can compile the relevant information to create one or more vessel files associated with the acquired raw data. Next, you can create a HIPS file, inside which all imported HIPS data is logically organized. The HIPS file will reference the vessel file(s) so that there is always a link back to the sensor information, used for processing.

Since HIPS 11.0 released version, the creation of **HIPS Vessel Files** (HVF) and **HIPS files** are optional, since data can be Imported and creating these files automatically during import. Vessel **From raw data files** is now available as well a **HIPS file** using auto locate function.

Vessel from Data

For the most popular formats the **installation parameters** file, will be automatically converted from the raw data files and used during processing. For formats which do not store the installation parameters, a zero vessel file will be used.



You can check what offsets, calibration values and parameters are used by HIPS when a Vessel From data is selected, opening the **InstallationParameter.xml** file.

Exercise 14.

a. Open the **InstallationParameter.xml** file on a Text Editor, located here: **C:\Users\<username>\Documents\CARIS\HIPS and SIPS\Hypack <date> <time>\TrackLines_Hypack <date> <time>\2011M_0901903**.

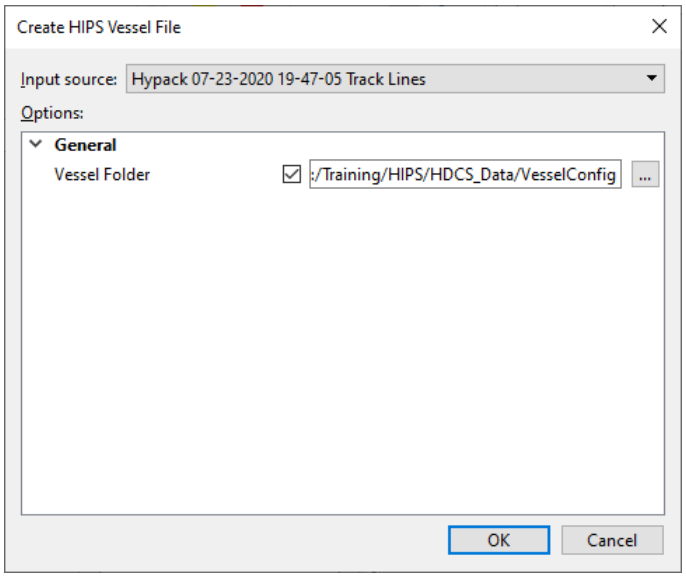
See all sensors offsets and calibration values are coming from the original Hypack HSX file.

Create HIPS Vessel File from Data

Alternatively, you can create a physical HIPS Vessel Configuration File (HVF) from data, and add or modify different sensor offsets, values and parameters, once it is open on Vessel Editor.

Exercise 15.

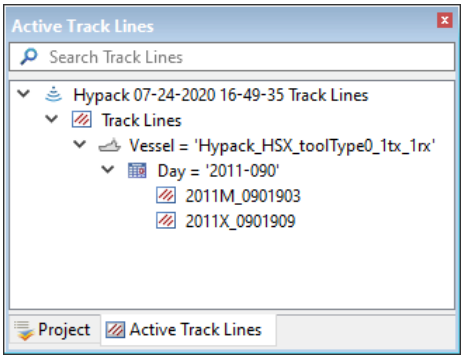
a. On **Layers** window, select the **Hypack <Date> <Time> Track Lines** layer and then select, **Tools > HIPS > Create HIPS Vessel File from Data…**



b. Enable the option **Vessel Folder**.

c. Click on browse (**…**) and select this folder to store the resulting HIPS Vessel File: **C:\Training\HIPS\HDCS_Data\VesselConfig**

You'll see a processing running and when it finishes, the vessel will be created with this name **Sonar_Format_ToolType_Xtx_XRx.hvf**, being **X**tx and **X**rx the number of Transducers transmitting (tx) and receiving (rx).



d. On **Active Track Lines** window, is now showing the new **Vessel = 'Hypack_HSX_toolType0_1tx_1rx'**

Vessel Editor

The Vessel Editor is used to create and edit HIPS Vessel Files (HVF). The HVF contains information necessary for combining all sensor data to create a final position/depth record. Since all sensor entries are time-stamped, one HIPS vessel file can be used for the life of a vessel. If a sensor is moved or added, the new offset information is given a new time stamp. HIPS processes will compare the date and time of the observed data with the date and time of the HVF sensor information to ensure that the appropriate offsets for that time are used.

Note: It is not possible to process sensor data time-stamped prior to the earliest HVF time stamp, as the program applies the most recent information.

Note: The positions of the sensors on the HVF may not be the same as the actual configuration of the vessel. For example, if sensor offsets are applied in the acquisition software, the HVF should describe the "corrected" position, not the actual position of the sensor.

In the following exercises you will open the Vessel Editor and configure a new vessel file. The vessel file configured will use the system information for the NOAA Ship Fairweather Hydro Survey Launch #2807.

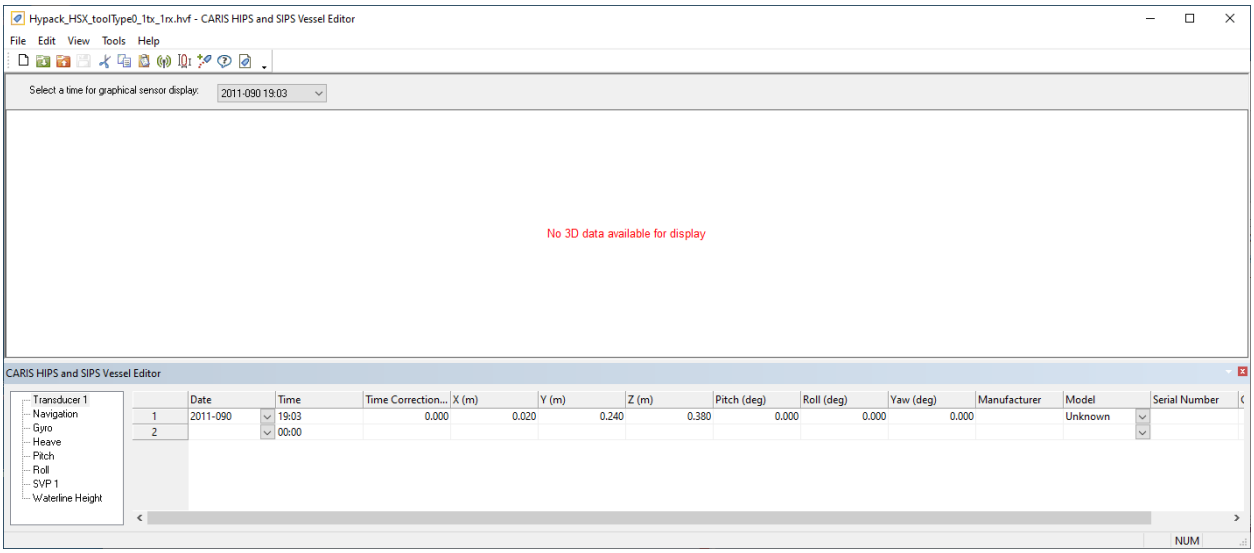
Exercise 16.

a. On **Project** window, unfold the HIPS file **Hypack <Date> <Time>**.

b. Unfold the **Vessels** layer

c. Right click on the vessel **Hypack_HSX_toolType0_1tx_1rx** and select **Vessel Editor** from the drop list.

This will open the CARIS HIPS and SIPS Vessel Editor.



d. Check all the sensors (**Transducer 1, Navigation, Heave, Pitch, Roll, SVP1, Waterline Height**) that all of them contain values from Hypack HSX files

e. Close the Editor selecting **File > Exit**.

Vessel Wizard

You will start by launching the Vessel wizard from Vessel Editor to begin the initial set-up of the vessel file. The Vessel wizard takes you through a step-by-step process to configure a vessel file from scratch. This vessel file can then be edited further in the Vessel Editor.

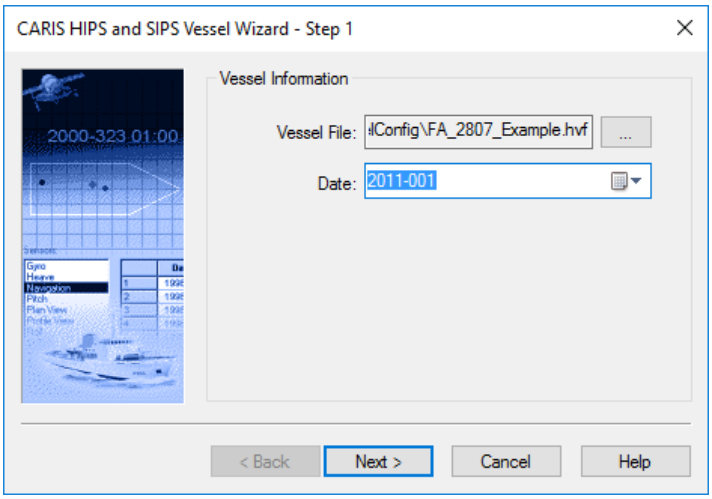
Exercise 17.

a. Click **Vessel Editor** icon, or select **Tools > Editors > Vessel…** option from the main menu.

This will open the CARIS HIPS and SIPS Vessel Editor.

f. Click the **New** icon or select **File > New** option from the Vessel Editor menu.

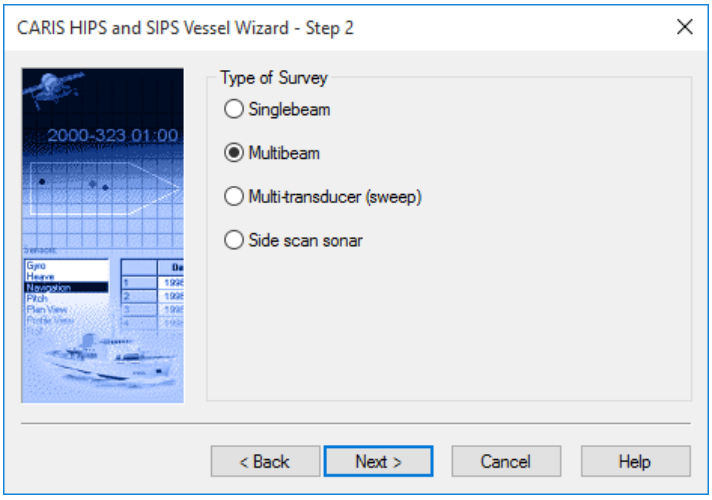
The CARIS HIPS and SIPS Vessel wizard will open. The first step of the wizard enables you to enter the vessel name and the mobilization date.



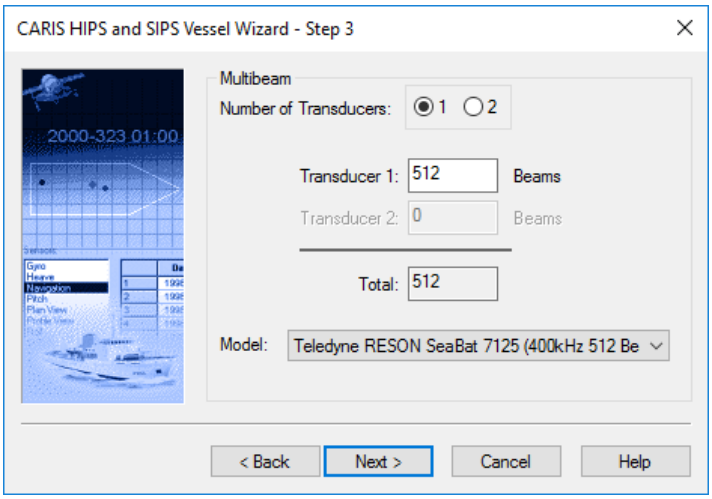
g. On **Vessel File** click the browse (…) and navigate to the folder **…\Training\HIPS\HDCS_Data\VesselConfig** and name the vessel **FA_2807_Example,** click **Next**.

h. On **Date** and type **2011** for the year and **001** for the day. You can click the Calendar button on the right side and double-click **January 1, 2011** as well**.** Use the arrows to change the month. Click **Next**.

Note: The vessel date must be before the start of your data collection. For easy identification, it is safe to use January 1 of the year the MBES was set up on the vessel.



i. In the Step 2 dialog box, click **Multibeam** as the Type of Survey and click **Next**.

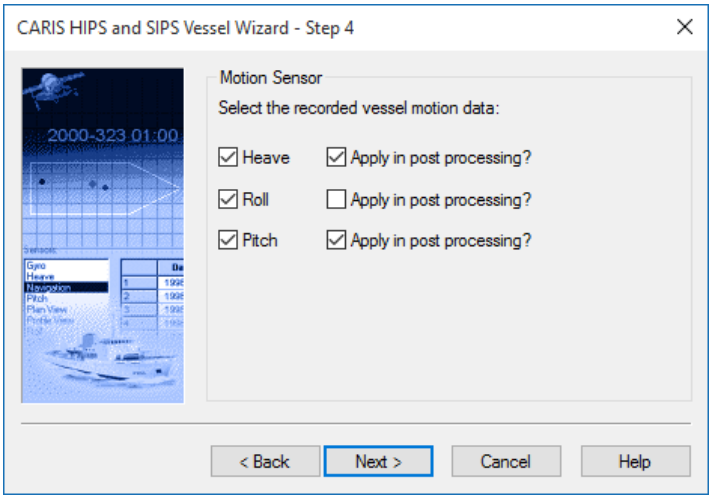


j. In the step 3 dialog box, set the following:
   - **Number of transducers = 1**
   - **Transducer Beams = 512**
   - **Model = Teledyne Reson SeaBat 7125 (400 kHz 512 Beams)**

In the CUBE processing workflow, the model selection is important as it specifies sonar characteristics to be used during TPU computations in HIPS. It is also used in Swath Angle surface creation.

Note: when configuring the HVF and other options in HIPS, it is important to remember that the options selected are unique and that each survey may require different settings

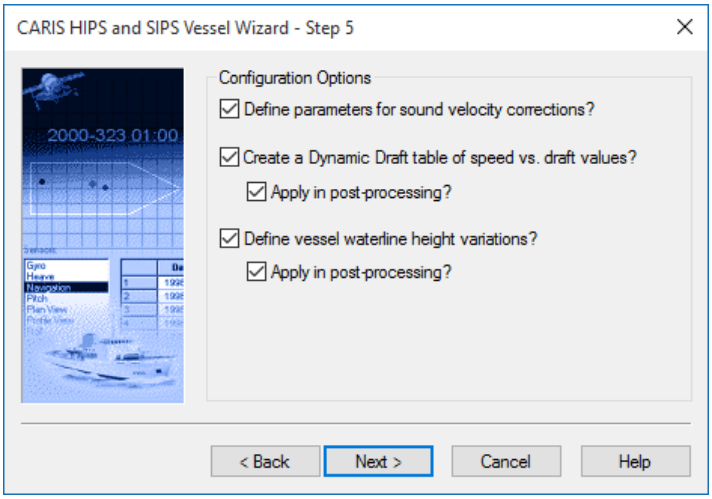
The sonar used for this training was roll-compensated in the acquisition system. However, it did not apply a heave or pitch component to the data during acquisition. Therefore, those must be applied in post-processing.



k. In Step 4 of the wizard, select the recorded motion sensor data by checking the boxes for **Heave, Pitch** and **Roll**.

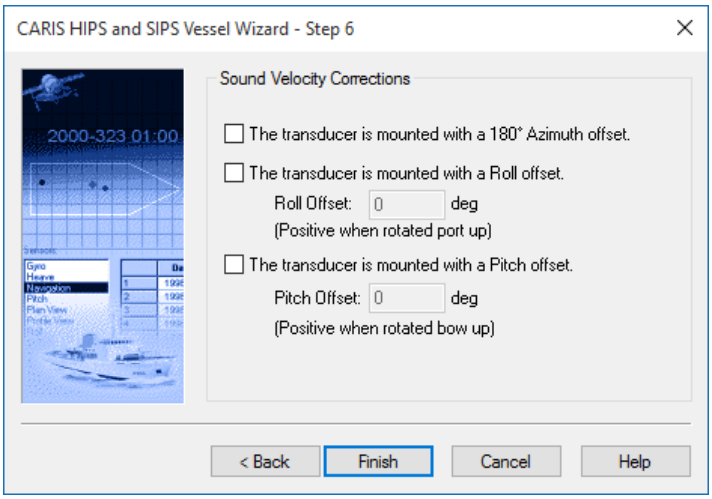
l. Select to **Apply in post-processing** for **Heave** and **Pitch** (NOT for **Roll**) to ensure its application during Sound Velocity Correction and click **Next**.

Note: Since Roll was compensated for during acquisition, setting "Apply in post-processing" to "Yes" would mean roll would be applied twice during Sound Velocity Correction.



m. In Step 5, click the Configuration Options for **sound velocity correction**, **Dynamic Draft** and **Waterline Height**.

n. For **Dynamic Draft** and **waterline height**, select "**Apply in post-processing**" and click **Next**.



o. No options should be selected in Step 6 as there are no large installation offsets.

p. Click **Finish.**

If SVC is to be run, then any mounting offsets must be filled out in Step 6 of the Vessel wizard for the SVP1 sensor section of the vessel file.

Vessel Shape

The following four steps of the Vessel wizard collect information to generate graphic views of the ship. All dimensions are in metres.

Advantages of the vessel shape diagram:

- Allows visual location of the Reference Point (RP).
- Allows visual location of all the sensors with relation to the RP.
- Allows immediate visual verification that offsets have been applied correctly.

You will be configuring the vessel shape of one of NOAA's *Fairweather* Hydro Survey launches.

Exercise 18.

a. Click the **Vessel Shape** icon or select **Edit > Vessel Shape** from the main menu.

b. Enter Plan View Shape dimensions, **total length 9.0 m**, **main length 7.0 m** and **beam 3.0 m**, and then click **Next**.

c. Enter Plan View RP position **1.5 m from starboard side**, **4.0 m from stern**. Click **Next**.

d. Enter Profile View Shape dimensions**, Keel to RP 0.5 m**, **Keel to Deck 1.2 m**. Click **Finish**.

By entering the vessel dimensions, a 3-D graphic display of the vessel and its sensors will be displayed. Compass axes and mouse can be used to manipulate the 3-D model of the vessel in the display:

- Use the mouse to tilt and rotate by dragging the compass end points, or use **<Ctrl> + left** mouse button to pitch or **<Shift> + left** mouse button to yaw.

- Zoom in and out by holding both the **<Ctrl>** key and right mouse button while moving the mouse up and down, or use the scroll wheel.

The vessel shape **does not** affect processed data. It is merely for visualization purposes in the HIPS Vessel Editor.

Once a vessel shape has been defined it can be modified by selecting **Edit > Vessel Shape** from the main menu or by selecting the **Vessel Shape** button from the main toolbar.

The sensor installation history of the ship is logged with time stamps so that a single HVF can contain many installations.

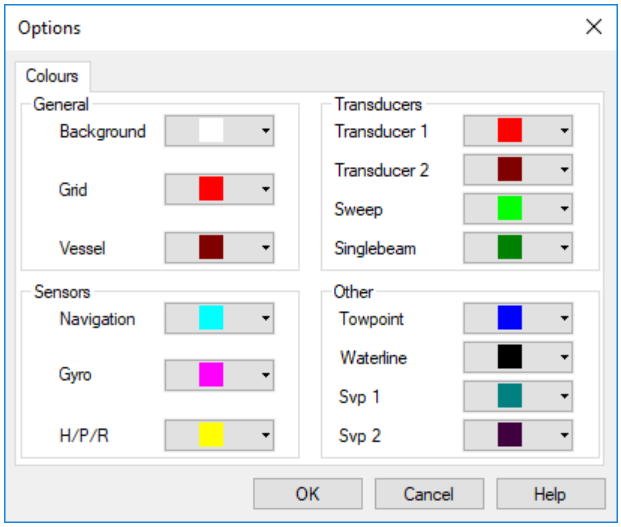
e. With the option **Select the time for the graphical sensor display,** If the vessel setup has changed, there will be multiple time stamps to select from. In this case there is only one entry, **2011-001 00:00**.

Options

The vessel editor has options to change the default colours for the HVF.

Exercise 19.

a. To change the default colours of these spheres, select **Tools > Options** to open the **Options** dialog box.



The **Colours** tab controls the colour selections used for the display of the Vessel Editor, Vessel Shape as well as the available sensors. These various sensors displayed with the Vessel Shape are represented by coloured spheres.

b. Click **OK**.

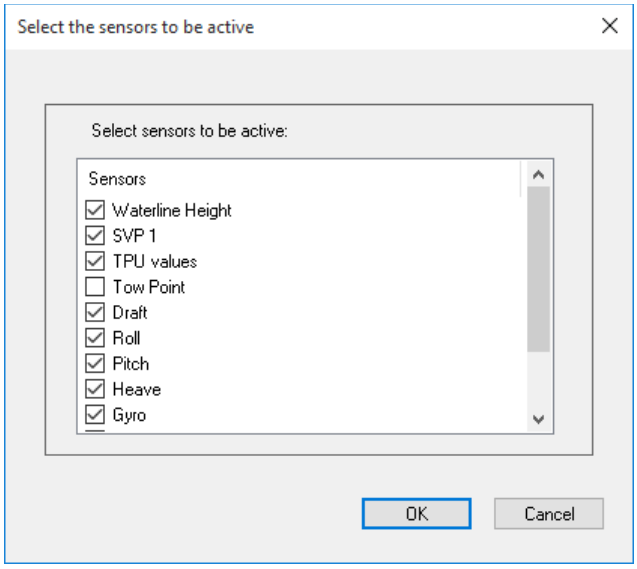
Active Sensors

Active sensors of the current vessel configuration file are listed in the lower left window of the Vessel Editor. Sensors can be added or removed from the display. Only active sensors are available for editing installation offsets, biases and errors.

- Several entries can be made for the same sensor using new dates and times.
- A time stamp is required for each table entry.
- By default, Tow Point, and TPU values are disabled for a multibeam sonar configuration.

Exercise 20.

a. Click **Active Sensors** icon or select **Edit > Active Sensors** from main menu.



b. Check the **TPU values** check box option, to display the TPU fields in the sensor data grid. Click **OK**.

Add Navigation Sources

With the release of HIPS 9.0, you can import different Navigation sources and define them on the HIPS Vessel File. The options for the Additional Navigation sources are:

Simrad EM Position Records

- 3000 (1)
- 3000 (2)
- 3000 (3)
- 86
- 90

Post Processed

- Applanix POSPac (SBET)
- Applanix POS Direct (Group 1)
- ASCII
- Terrapos
- NovAtel
- NavLab
- Starfix

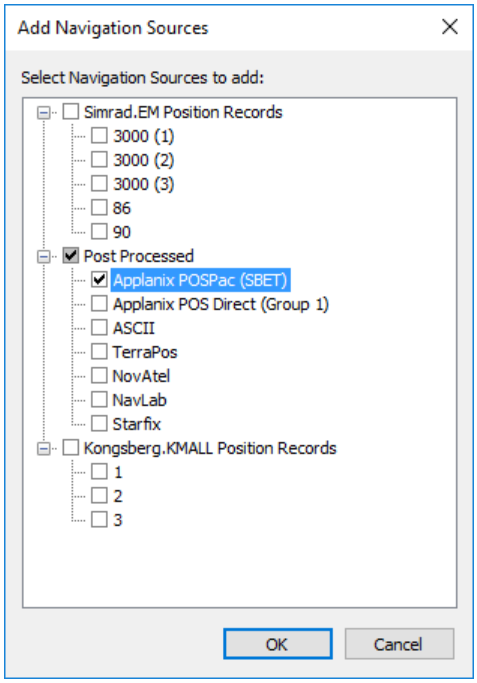
Kongsberg.KMALL Position Records

- 1
- 2
- 3

Note: In case an additional navigation type is used and that does not have a corresponding HIPS Vessel File entry, it will use the default parent "Navigation" sensor values for the offsets. Therefore, if only one navigation type is used it is not necessary to add any Additional Navigation sources.

Exercise 21.

a. Click the **Add Navigation Sources** icon or select **Edit > Add Navigation Sources** from main menu.



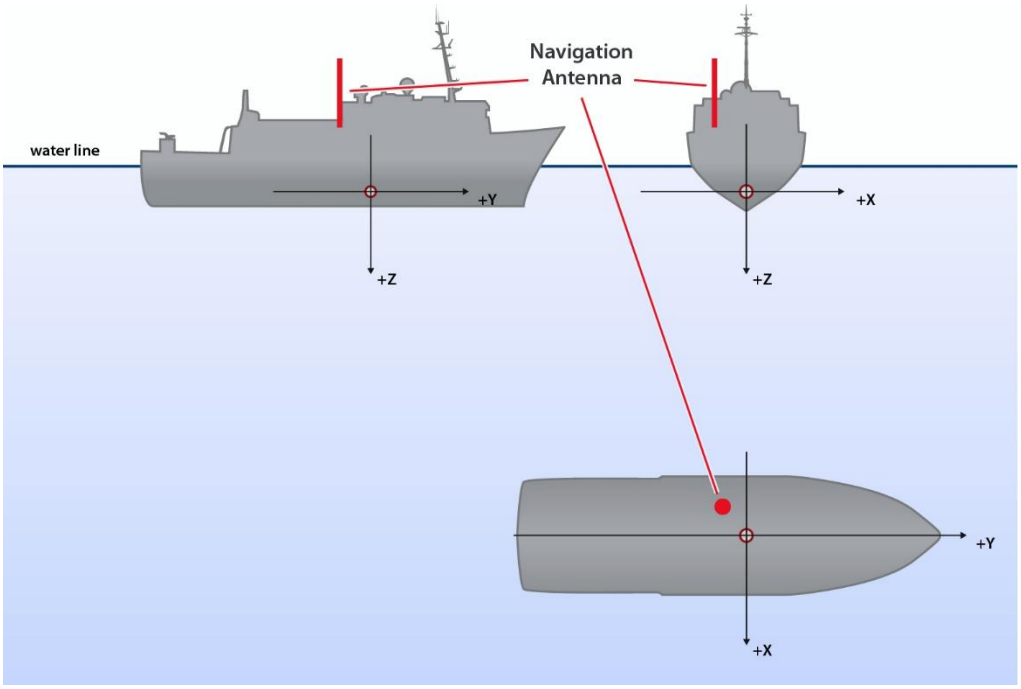
b. Check the **Post Processed > Applanix POSPac (SBET)** check box option, to add this new Navigation Source to the Navigation Section of HIPS Vessel File. Click **OK**.

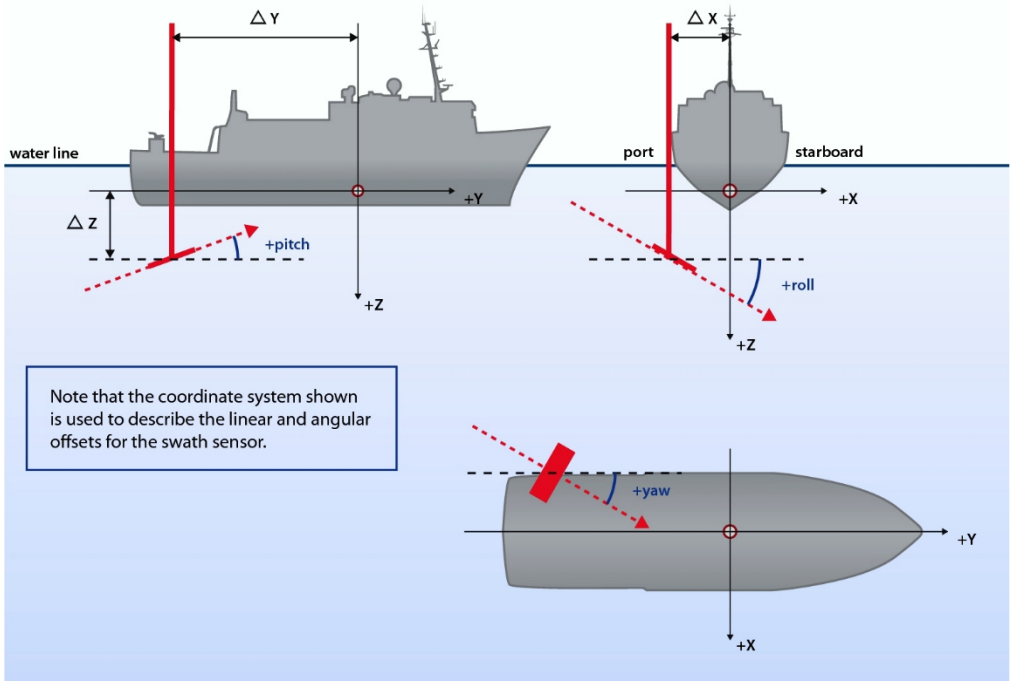
c. Expand the tree on the **Navigation** Section of HIPS Vessel File. You'll see the new section **Applanix POSPac (SBET)** with the same Date and offsets, as the original Navigation.

Note: If the offsets differ from the Primary GPS they should be entered.

Sensor Section

Each active sensor for the vessel is listed in the bottom left window of the vessel editor. The vessel file can be updated with sensor offsets and other information, as it becomes available during future surveys.





Now that you have created a HVF for this vessel, you will continue with entering the relevant information for it.

Exercise 22.

a. Enter the following offsets for **Transducer 1:**
X = 0.019m
Y = 0.244m
Z = 0.481m
Pitch = 0.0°
Roll = 0.0°
Yaw = 0.0°

Note: Always ensure the appropriate device model has been set in the **Model** field of the **Transducer 1** sensor within the HIPS vessel file, as these values are utilized during TPU computation as well as surface creation. If a sonar model is not available within the dropdown list, new entries can be added to the **devicemodels.xml** file. Additionally, the existing values can be updated if the settings for your sonar differ from those entered within the file. The **devicemodels.xml** can be found in the HIPS **System** directory of the HIPS installation. For additional information of the configuration of the values within the **devicemodels.xml** file, refer to **https://www.teledynecaris.com/en/products/total-propagated-uncertainty/**. If a sonar is not included in the file, these values can be obtained from the sonar manufactures and sent to CARIS to be added in a future release. Also, please refer to the **TechNote – HIPS – Regular Gridded Surface Generation.pdf** for some additional information on how these values are utilized within the algorithms used during surface creation.

b. Enter the following offsets and selections for **Navigation**:
X= 0.0, Y= 0.0 and **Z= 0.00**.

c. Expand the tree on the **Navigation** Section of HIPS Vessel File. Select the **Applanix POSPac (SBET)** and enter the following offsets and selections:
X= 0.0, Y= 0.0 and **Z= 0.00**.

d. Do not enter any time error or error value for **Gyro**.

e. Enter **X=0.00**, **Y=0.000 Z=0.000** for **Heave**, and ensure **Apply** is set to **Yes**.

f. Do not enter any time error or error value for **Pitch**, and ensure **Apply** is set to **Yes**.

g. Do not enter any time error or error value for **Roll**, and ensure **Apply** is set to **No**.

h. Enter an offset of **-0.090** for **Waterline** and ensure Apply is set to **Yes.**

The offsets are zeros for the Navigation and the Motion (Heave) sensors because all of the lever arms for the antenna position and IMU position were accounted for, in the Applanix POS/MV unit onboard the vessel.

In the same way Applanix SBET were post processed in POSPac software from the Real Time data, therefore all the offsets for those should be zeros as well.

Dynamic Draft

Dynamic draft (or "squat") is the phenomenon where a change in vessel speed leads to a vertical displacement of the vessel depending on the shape of the hull, survey depth and seafloor morphology. HIPS can account for this vertical displacement by entering values of speed vs. draft in a table under the Draft sensor. These values would have presumably been observed during a vessel sea acceptance test. Dynamic draft (the Draft sensor in the HIPS HVF) should not be confused with Static Draft, which is accounted for as Waterline Height in the HIPS HVF.

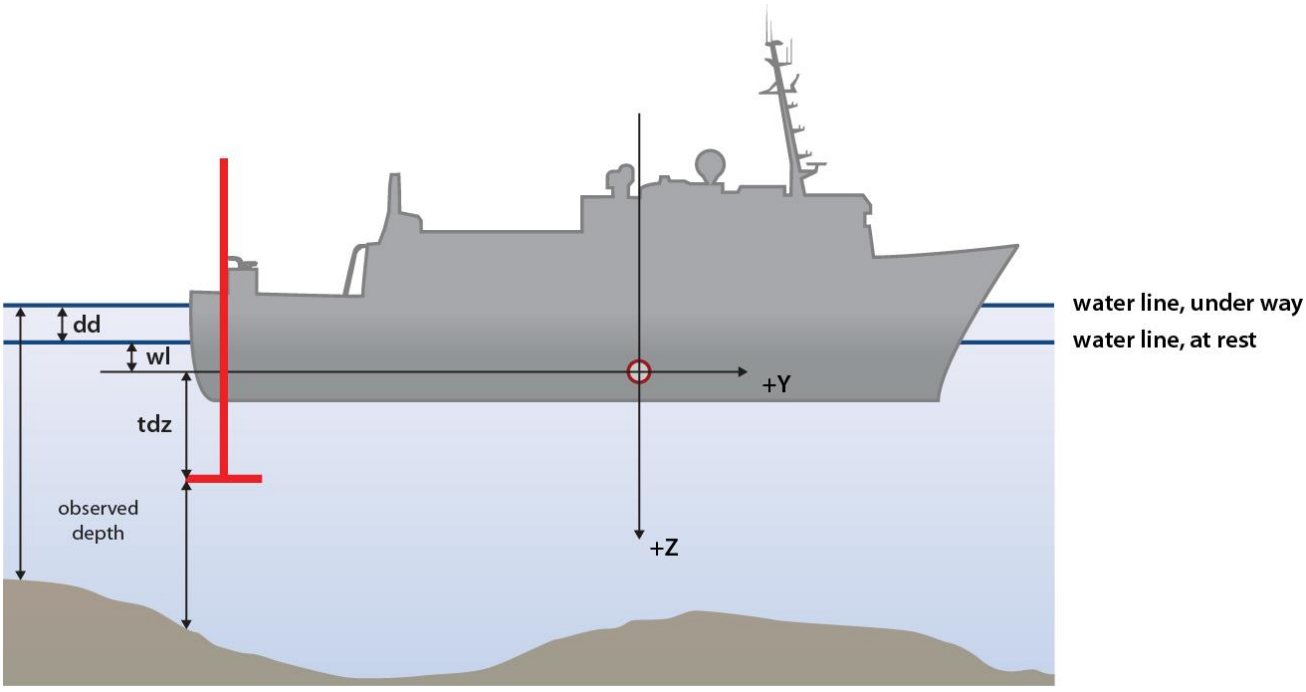
Exercise 23.

a. Click the **Draft** sensor. Do not adjust the time. Under the Error column, click "**...**" next to **Edit**.

b. Enter the following error values into the table.

	Draft (m)	Speed (m/s)
1	0.000	0.972
2	0.000	1.944
3	0.010	2.916
4	0.020	3.888
5	0.030	4.860
6	0.050	5.832
7	0.070	6.803
8	0.090	7.775
9	0.090	8.747
10	0.060	9.719
11	-0.010	10.691

The actual vessel draft (distance from Waterline to Transducer), is determined from the water line and transducer Z. The dynamic draft (squat) can be used to adjust the vessel draft to compensate for an error or changes due to vessel squat.



Reduced Depth = Observed depth + tdz – wl + dd.

[wl] is the vertical distance from the RP to the waterline. The water line value is used in final vessel draft computation and is a measure from the RP and is **positive down**.

[tdz] is the vertical distance from the RP to the transducer head (Transducer 1 - Z). SVP1 - Z is used if data is sound velocity corrected.

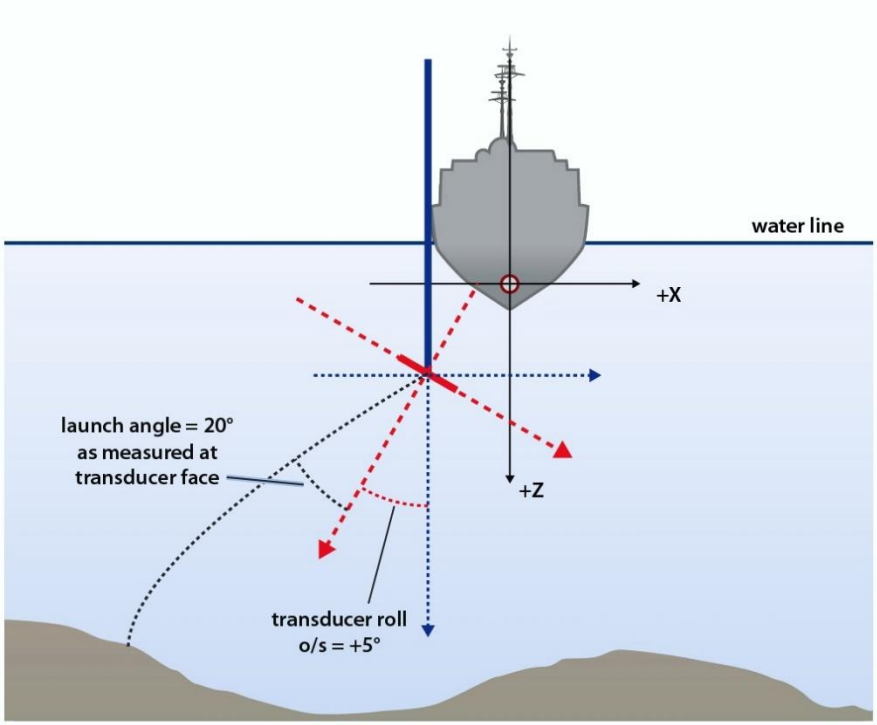
[dd] Dynamic Draft is the change in draft due to vessel speed.

Note: Final depths are also compensated for tide, dynamic pitch, roll, and heave.

Sound Velocity Values

In order to convert travel time and angle information into across-track and depth values the following information is necessary.

- Launch (or reception) angle from / to the transducer face.
- Travel time.
- Sound Velocity Profile.
- Orientation of the transducer face to the mounting pole. This has two components:
  - Instantaneous transducer face pitch and roll (vessel motion).
  - Constant transducer face pitch and roll mounting offsets (orientation at rest).



Actual beam angle (at rest) = transducer pitch & roll o/s + launch angle
e.g., dealing with roll component only: actual beam angle (at rest) = 5° + 20° = 25°

A combination of the orientation of the transducer face and the launch angle produces the angle of the beam with respect to the local vertical.

When sound velocity correction is performed in HIPS, the Pitch, Roll, Azimuth entries for the SVP 1 sensor section in an HVF file, are used to determine the constant pitch and roll of the transducer face.

Transducer head angular offsets can be entered to correct for misalignment of the transducer head. The orientation of the transducer face is determined from the transducer head angular offsets. The following is an example of how the SVP1 field is defined:

- Launch angle = 20°
- Misalignment of the transducer head = +5° (starboard down).
- Actual Beam Angle = 20° + 5° = 25°

When HIPS performs the sound velocity correction routine it will use the SVP section of the HVF to compute the actual beam angle (e.g., 25° in the above example). It will correct the actual beam angle for pitch and roll, any heave will be applied and the water line entry will be used to determine the proper starting layer in the sound velocity profile. To determine the across-track, along-track and depth for a particular beam, the actual beam angle, the SVP, and the travel time based on a ray-tracing algorithm will be used to determine an observed depth.

Exercise 24.

a. Enter the following offsets for **SVP 1:**
X,Y,Z will default to the settings in **Transducer 1**.
Pitch = -1.490°, about the Port/Starboard (X) Axis, positive bow up**.**
Roll = 0.100°, about the Fore/Aft (Y) Axis, positive starboard down**.**
Yaw = 0.500°, about the Z Axis, positive clockwise**.**

Values determined in calibration can be entered in SVP1 section so that they are applied on SVC.

Total Propagation Uncertainty (TPU) Values

The Vessel Editor has the ability to define uncertainty estimates for each sensor in the HVF. The uncertainty estimates, which describe the accuracy of each sensor, are later used in the calculation of Total Propagated Uncertainty (TPU). By selecting the **TPU values** sensor from the **Active Sensors** box in the Vessel Editor, you will be able to define sensor uncertainties, time latency uncertainties and uncertainties associated with the measured offsets.

In the Offsets portion of the TPU values you will define the relationship between the sensor positions by entering the measurements between the sensors themselves and not to the RP (i.e. Navigation sensor – Transducer). The measurements between the sensors are necessary in order for HIPS to compute TPU. If these have not been measured directly, they can be calculated from the offsets measured from the RP to the various sensors.

In the Standard Deviation (StdDev) fields of the TPU values, you will enter the sensor uncertainties at 1-sigma (68%). The uncertainties can be obtained from the manufacturers of the sensors. The units for each associated sensor uncertainty will depend on the sensor itself (i.e. navigation uncertainties are in metres and pitch uncertainties are in degrees). Timing uncertainties and measurement uncertainties can also be entered. Measurement uncertainties are dependent upon the method used to measure the offsets.

All information for the TPU values will be stored in the HVF and used for the computation of a depth and horizontal uncertainty value for each sounding. The TPU values can later be used to filter data and create a Bathymetry with Associated Statistical Error (BASE) surfaces (uncertainty and CUBE method).

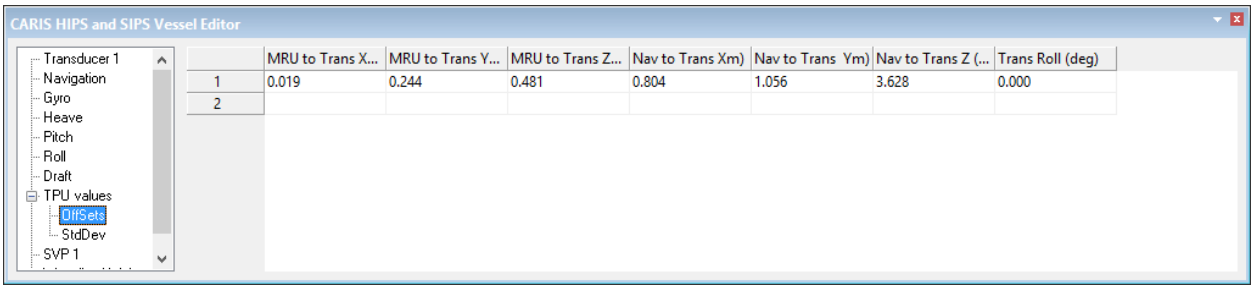
Exercise 25.

a. Click the **TPU values** section and enter the Date and Time for the **TPU values** in the sensor data grid, enter the date **January 1, 2011** (**JD 2011-001**)

b. Click the + to display the sections: **Offsets** and **StdDev** under **TPU values**.

c. Enter the following values in the **MRU to Transducer** and NAV to Transducer Offsets section of the TPU Values sensor:

	X	Y	Z
MRU to Transducer	**0.019**	**0.244**	**0.481**
Nav to Transducer	**0.804**	**1.056**	**3.628**

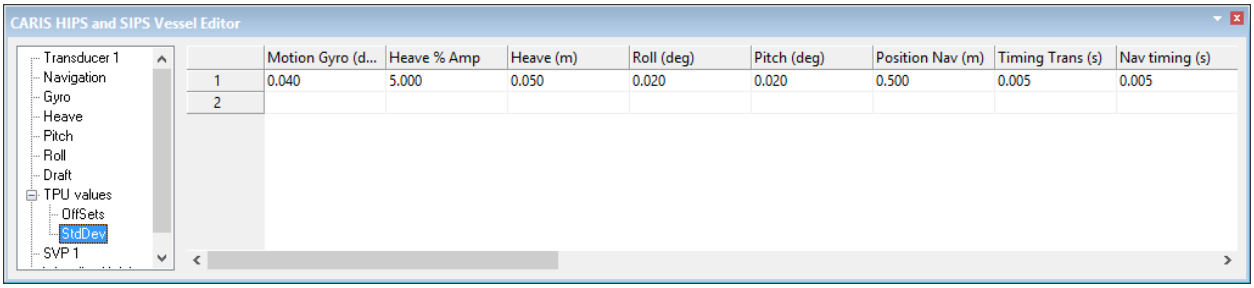


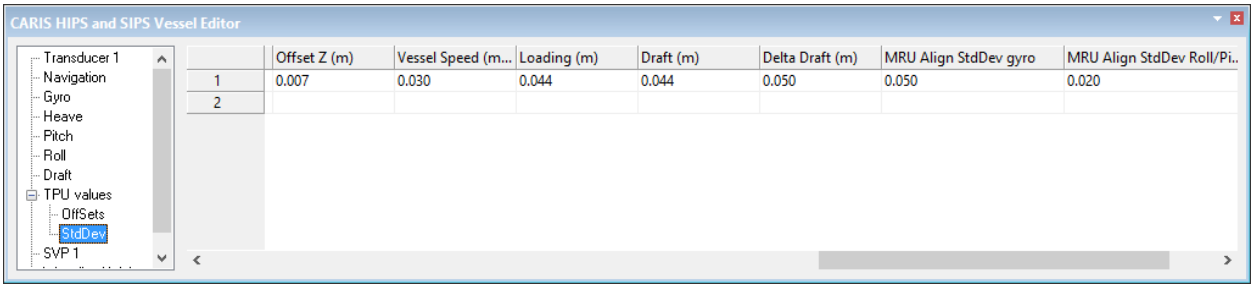
It is necessary to enter the uncertainty values associated with the auxiliary sensors within the vessel set-up. The multibeam system utilized to collect the bathymetric data for this exercise contains a POS/MV 320 (RTK with 4m baseline) to provide positioning and attitude information. For the initial set-up of the uncertainty model, the published values provided by the manufacturers of the pertinent sensors could be used. Once you gain more experience with the vessel set-up, it may be noticed that more realistic uncertainty values are required to better reflect the overall uncertainty model of the vessel.

CARIS provides a webpage, which lists the manufacturers values of a wide range of popular sensors used in the hydrographic community. You will use this resource to acquire the associated uncertainties for the positioning and attitude determination in this survey. This information can be found at **https://www.teledynecaris.com/en/products/total-propagated-uncertainty/**

d. Enter the following values:
Motion Gyro: 0.040
Heave % Amp: 5.000
Heave: 0.050
Roll: 0.020
Pitch: 0.020
Position Nav: 0.500
All **timing** uncertainty values: **0.005**
Offsets measurement uncertainty **X,Y,Z: 0.007**
Vessel Speed: 0.030
Loading: 0.044, Loading uncertainty
Draft: 0.044
Delta Draft: 0.050
MRU Alignment StDev Gyro: 0.05, MRU alignment uncertainty with respect to gyro.
MRU Alignment StDev Roll/Pitch: 0.020, MRU alignment uncertainty with respect to roll/pitch.

e. **Save** your Vessel File when all values are entered in the TPU Values sensor.





f. Select **File > Exit** once you have completed the setup of the HIPS Vessel File.

Change Vessel Configuration File

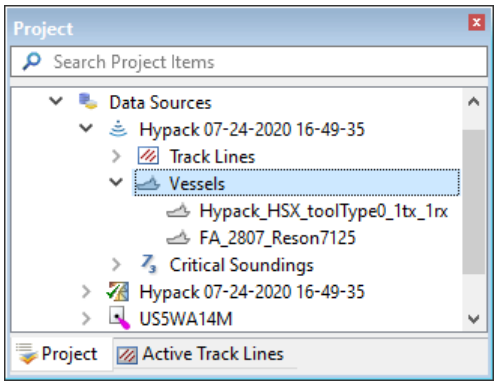
It is possible for you to change the physical vessel from data you created previously, with another pre existent vessel, like the one you just created on this last exercise.

Exercise 26.

a. On **Project** window, unfold the HIPS file **Hypack <Date> <Time>**.

b. Right click on the **Vessels** layer and select the option **Add Vessel**.

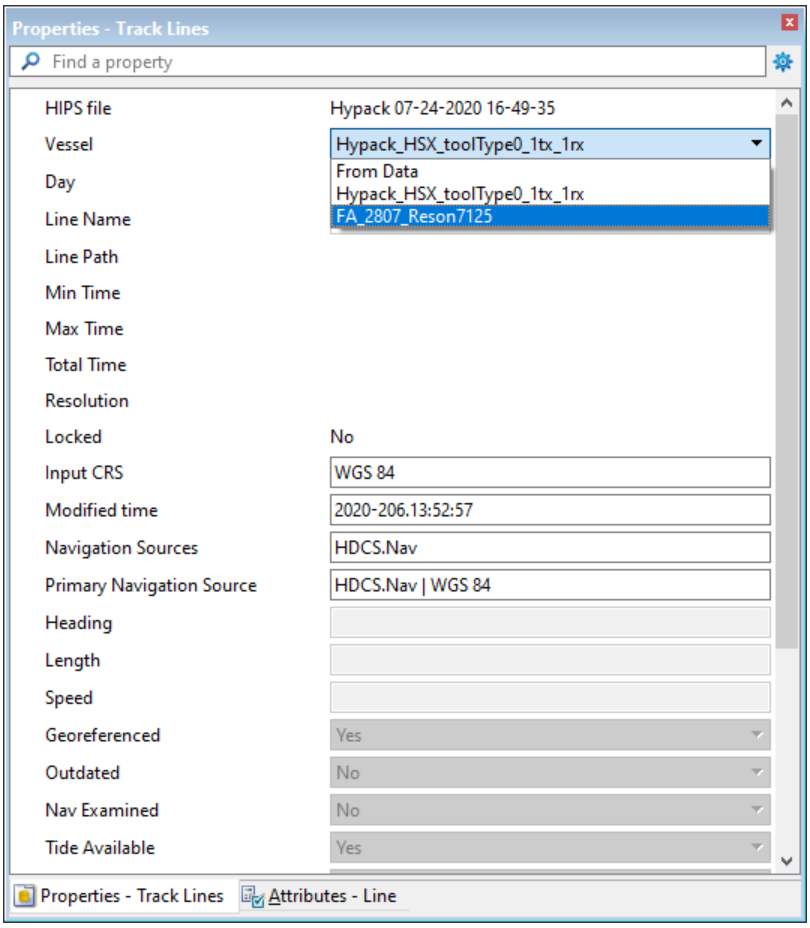
c. Select the Vessel **FA_2807_Reson7125.hvf** located on this folder: **…\HIPS\HDCS_Data\VesselConfig**.



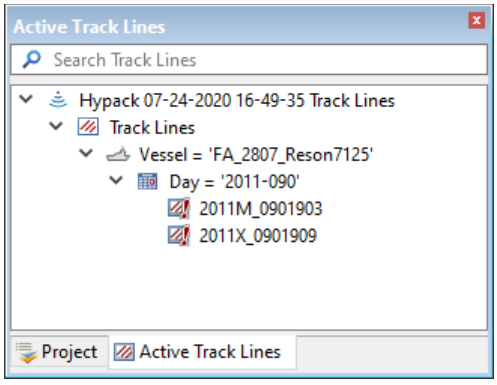
Then you'll see two Vessel Configuration Files inside **Vessels** on Project window.

d. In the **Layers** window, select **Hypack <Date> <Time> Track Lines** layer**.**

e. On Active Track Lines, select the layer **Vessel = 'Hypack_HSX_toolType0_1tx_1rx'**



f. On the **Vessel** drop list select the vessel **FA_2807_Reson7125**.



You can see the vessel has changed and unfolding the day, you'll notice both lines are now outdated (showing this exclamation mark icon) and they need to be re georeferenced. With the upcoming exercises, these lines will be updated.

Note that it is possible to add a new vessel file to the HIPS project by selecting the the HIPS file in the project window and right click on Vessel>Add Vessel. Then it is possible to assign this vessel to some track lines using the above steps.

Create a New HIPS file

The *.hips file is a SQLite database, which stores project metadata, line information, critical soundings, side scan contacts and navigation data under a CARIS Simple Feature specification.

If you want to open a file created prior to version 8.0, it had a *.HPF (HIPS Project File) file. This *.hpf file should trigger an update asking you to set the coordinate reference system. If the HPF is absent and the HIPS Project is required to open on the current version, you should use the Upgrade Project option (**File > Import > Upgrade Project...**), giving to the software the location of the Project (located within the HDCS_Data folder), the software will create a HIPS file for it, allowing you to open the project on the current version.

If you want to open a HIPS file created prior to version 11.0, due to the recent changes on the HIPS file Structure, the software will create a new HIPS file (compatible with HIPS 11) and will rename the previous HIPS file extension to **.hips.backup MM-DD-YYYY hh-mm**. If you want to open that HIPS file back in previous versions than 11.0, all you need to do is to rename the file generated back to **.hips**

Note: We do not recommend deleting lines outside of the HIPS application.

In HIPS, there is a "**Check HIPS File**" function, you can find it in the right-click menu on the **Project** window. It scans all of the navigation sources in the project to make sure all of the raw files are still available, and prompts you to fix paths if the raw data was moved, or the whole HIPS folders were moved from one machine to another one. The function runs automatically in the background when a **HIPS file** is opened in HIPS.

The HIPS file creation as well can be done during Import Sensor Data, to simplify the workflow.

Processing Workflow

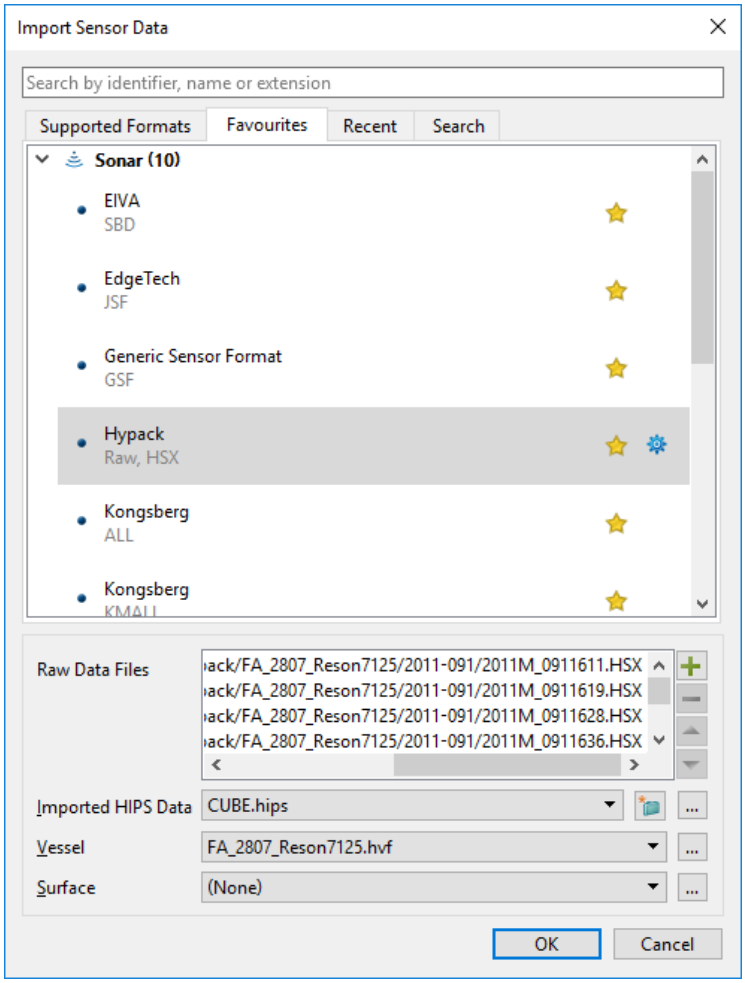
Raw/unprocessed survey data is imported into HIPS/SIPS format through the **Import Sensor Data** process. In order to Import raw data, you must know format information specific to the data. Data that is imported to HIPS format may be in varying stages of completion, depending on the data format options. HIPS supports over 40 different raw formats for importing. Once imported into HIPS format corrections can be made to the data.

Import Sensor Data

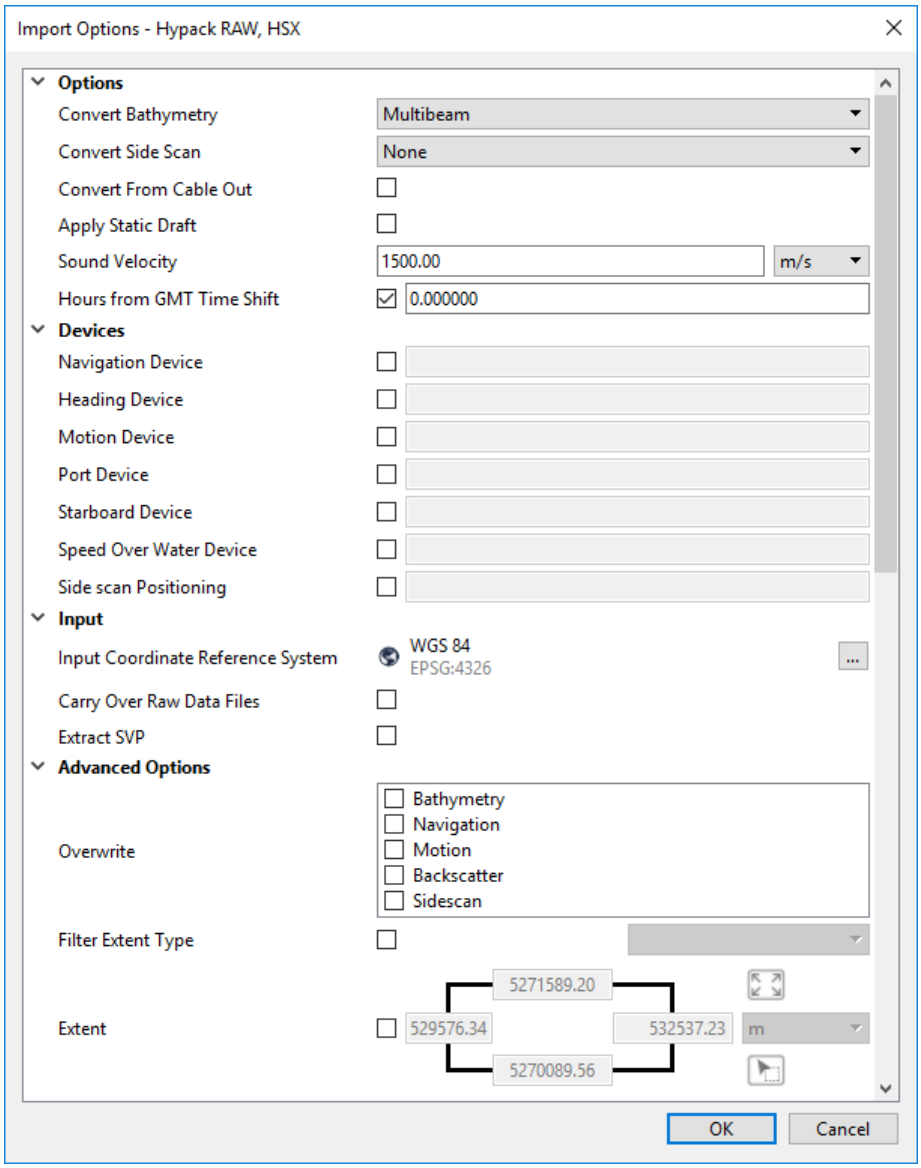
The Import Sensor Data window dialogue, gives you the options to import raw/unprocessed data into HIPS/SIPS format.

Exercise 27.

a. Click the **Import Sensor Data** icon or select **File > Import > Sensor Data...** from the menu.



b. In **Formats**, click **Hypack RAW, HSX** from the list of formats**.**



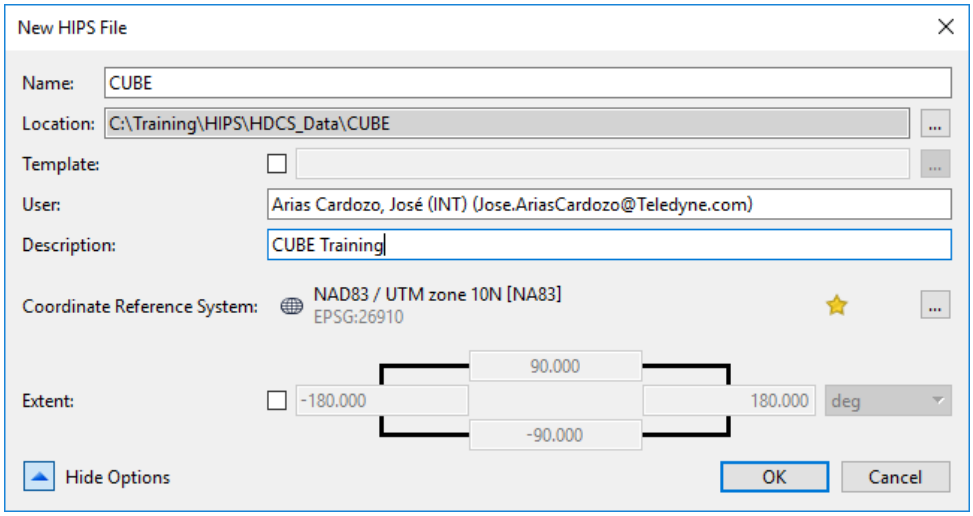
c. Click on the **blue cog** on the right side of **Hypack** format, this will launch to the **Import Options – Hypack RAW, HSX** window.

d. Check that **Convert Bathymetry** option is set to **Multibeam**. Leave all other options by default. Click **OK**.

e. In Raw Data Files, click on the **+** icon and navigate to the folder **…\Preprocess\CUBE\Hypack\2807** and select all lines.

On **Imported HIPS Data**, the user can use a previous created **.hips** file, or can create a new one using the icon **Create a New HIPS file** on this step.

f. Select **Create a new HIPS file** icon from **Imported HIPS Data option**.



The Name by default is **New HIPS data**, followed by today's date, also the location by default is **My documents** on the Local Machine. Those names and locations can be changed at the time you're creating a HIPS file.

Selecting the blue arrow, **Show options** allows you to access additional options during the HIPS file creation.

A **Template** can be used in order to just change Names and locations but always using the same **User**, **Coordinate Reference System (CRS)** and **Extents**.

The **User** name is taken from the Login session username

You can type a brief **Description** of the HIPS file.

Also the **Coordinate Reference System** of the HIPS file can be defined here.

Finally the **Extent** of the project is the whole earth by default, but you can restrict this, changing the **Coordinate** numbers, using the **display extents** or a **box selected on the display**.

g. In **Name** type **CUBE**

h. In **Location** Browse to **…\HDCS_Data** folder.

i. Make click on the blue arrow down **Show Options**

j. In **Description** type **CUBE Training**

k. For the **CRS** Pick **NAD83 / UTM zone 10N EPSG:26910**

l. Click on **OK**

m. On **Vessel**, click browse (**…**) and navigate to **…\Training\HIPS\HDCS_Data\Vesselconfig** and select the file **FA_2807_Reson7125.hvf**.

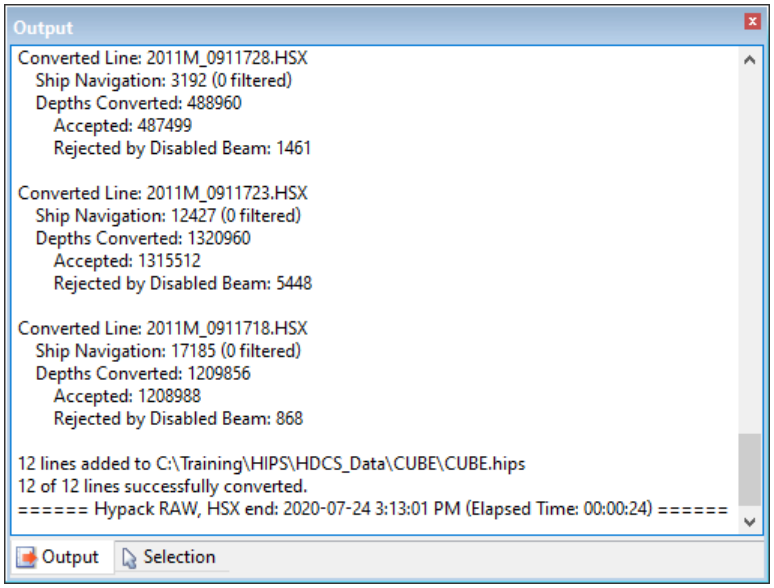
Since HIPS 11.1 release, the you can generate a **Regular Gridded Surface** or **Variable Resolution Surface** automatically during import. You will later create surfaces manually.

n. On **Surface** select **(None)**.

o. Click **OK**.

Once the process is complete, the **Output** window displays an Import report. Review the report before continuing.

If the **Surface Auto Create** option was selected, after the Import Sensor data process is completed, a **Georeference Bathymetry** process is executed. In **Tools > Options > Application Defaults** you can define what processes will be executed in **Georefrence Bathymetry** (**SVC**, **Compute TPU** and/or **Tide**), otherwise it will run **Georeference Bathymetry** just using **None** for **tide** (No **SVC** or **Compute TPU**).



Now that the data has been imported and added to the HIPS file, you can start applying corrections. The exercises below follow a generic multibeam data processing workflow, showing various tools available in HIPS and SIPS.

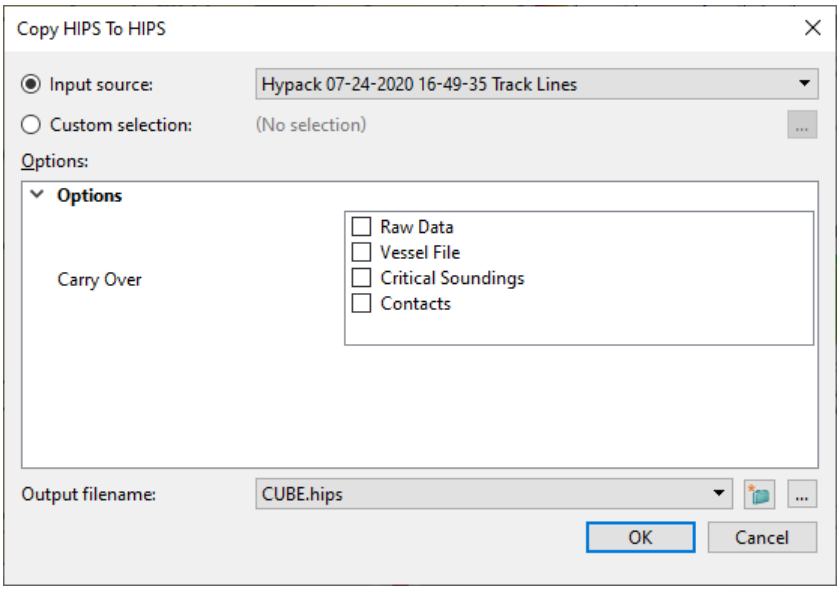
Copy to / Move to function

This exercise will use the **Copy to** function. This function copies selected lines from one HIPS file to another HIPS file. Another function is the **Move to**, instead of keeping the line in the original HIPS file, it removes the Track Lines from the original HIPS file. It is recommended to use one of these two functionalities to move a project from one location to another.

Exercise 28.

a. In the **Layers** window, select **Hypack <Date> <Time> Track Lines** layer**.**

b. Go to the menu **Edit > Track Lines > Copy To.**



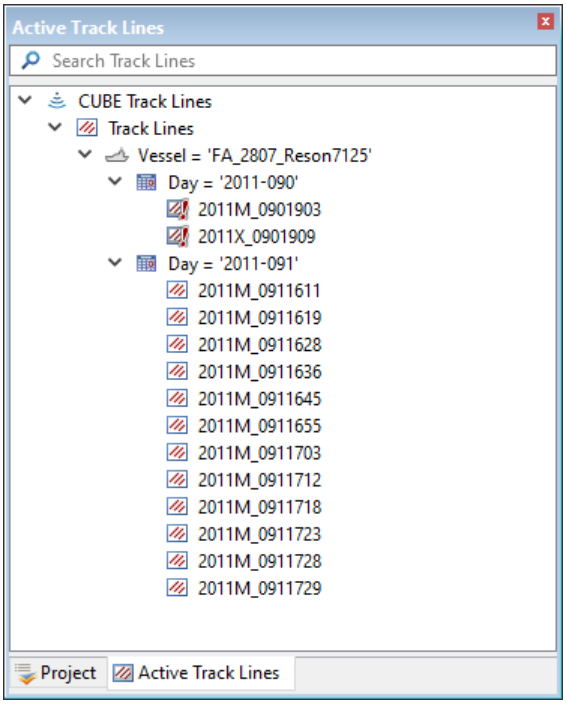
Note: Is possible to create a new HIPS file that will receive the line directly from the Copy HIPS file window. Enabling the carry over option, will create copy of this information in the HIPS file location.

c. Make sure the Input source is the **Hypack <Date> <Time> Track Lines.**

d. Let the **Options** (disabled) by default

e. Select **CUBE.hips** as output file.

f. Click **OK**



Now you'll see on the CUBE HIPS file that these two lines were carried over to this HIPS file. You will also notice that they both have the outdated status (the red exclamation mark)

g. On the **Project** window, right click on the **Hypack <Date> <Time>** HIPS file and select **Close Source** from the drop list.

h. On the **Project** window, right click on the **Hypack <Date> <Time>** Surface file and select **Close Source** from the drop list.

i. Save the project by selecting **File > Save > Save Project As…** call the project **CUBE** under the folder **C:\Training\HIPS\Projects** and click **Save.**

Import Delayed Heave

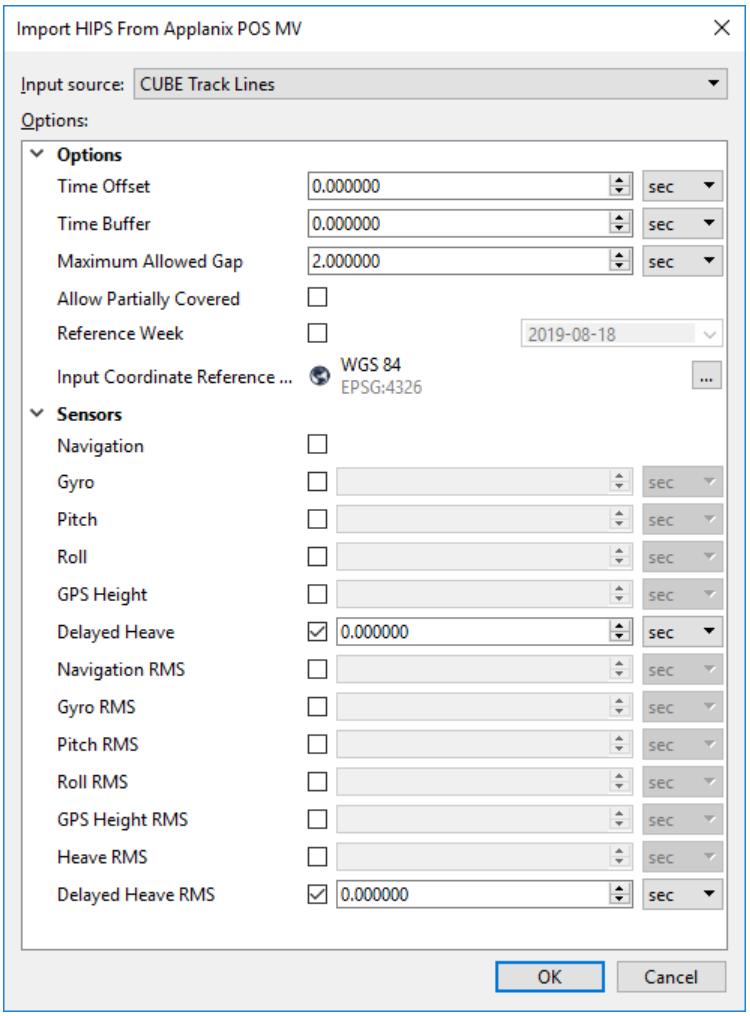
Delayed heave data, like Applanix TrueHeave or Kongsberg PFree Heave, is post-processed, filtered heave information created and stored in separate files after acquisition. These files are not imported into HIPS during conversion and must be imported separately to the track lines.

The binary files provided for these training exercises contain both; Delayed Heave information and Delayed Heave Uncertainty (RMS).

Exercise 29.

a. On **Layers** window, select the **CUBE Track Lines** layer and within the **Active Track Lines** window highlight the **Track Lines** layer and then select **File > Import > Auxiliary Data > Applanix POSMV...**

b. In the **Open** window, go to the directory **…\Preprocess\CUBE\Applanix\DelayedHeave\2807** and select the files **2011_090_2807.000** and **2011_091_2807.000**



c. It will Open the **Import HIPS From Applanix POS MV** window. On **Input source**, choose **Selected Track Lines**.

d. On the **Options** section leave **2** for **Maximum Allowed Gap, Input Coordinate reference System** as **WGS 84** and leave all other options at default settings.

e. On **Sensors** Section Enable **Delayed Heave** and **Delayed Heave RMS** checkboxes for **Import Data**, enter in **0.00** for each enabled data type and make sure the units selected are **sec** (seconds) from the drop list. Click **OK**.

Note: When a value of zero is entered no down sampling will occur on the generated files and ALL data from the imported data will be utilized.

The **Reference week** option is useful when you have one file collected past Saturday midnight UTC time in to Sunday. This option would need the reference for the first week of that file (any day of that week), assigning the rest of Sunday data, the proper week after timestamps.

The Time Offset option can be used to apply an offset to synchronize the time stamps within the Delayed Heave files to the rest of the project. Also, if Delayed Heave RMS data has been imported for a line, it will override Down/Heave RMS data imported by the Import Real Time Uncertainty Data process when Compute TPU is run.

Data is only imported at this time and NOT yet applied to the multibeam soundings. Application of Delayed Heave information will occur during Georeference Bathymetry (Sound Velocity Correction if applied), so it is important to import these data prior to that step.

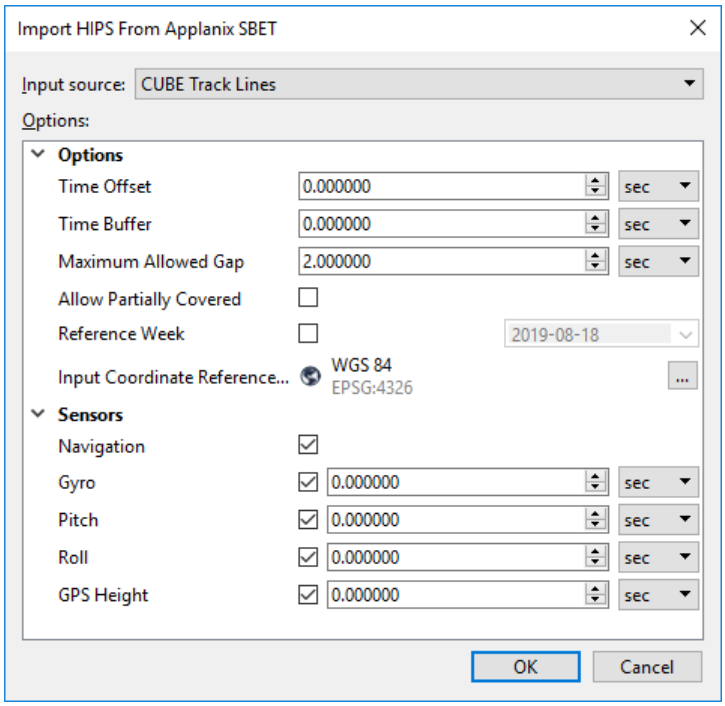
Import Attitude / Navigation Data

Navigation and attitude data was post processed in the Applanix POSPac software and a file of Smoothed Best Estimate of Trajectory (SBET) is provided. In HIPS, attitude and navigation data from Applanix POS/MV (raw) or POSPac (post-processed SBET) files can be imported to selected track lines using the **Import HIPS from Applanix SBET** dialog box.

Exercise 30.

a. On **Layers** window, select the **CUBE Track Lines** layer and within the **Active Track Lines** window highlight the **Track Lines** layer and then select **File > Import > Auxiliary Data > Applanix SBET…**

b. In the **Open** window, go to the directory **…\Preprocess\CUBE\Applanix\SBET\2807** and select the file **2011_090_2807.sbet** and **2011_091_2807.sbet**



c. It will Open the **Import HIPS From Applanix SBET** window. On **Input source**, choose **Selected Track Lines**.

d. On **Options** section, leave all options by default.

e. On **Sensors** section, enable **Navigation, Gyro, Pitch, Roll** and **GPS Height** checkboxes and enter a **0.00** sampling rate for each enabled data type and make sure the units selected are **sec** (seconds) from the drop list.

f. Click **OK**.

The selected lines will have a second source of navigation (Applanix_SBET) and new Motion (Pitch, Roll, Gyro and GPS Height) records, coming from the SBET files. This motion overwrites the original Values from importing.

Data is only loaded at this time and NOT yet applied to the multibeam soundings. Application of Attitude/Navigation information will occur during Georeference Bathymetry (Sound Velocity Correction if applied in HIPS), so it is important to load these data prior to that step.

Import Real Time Uncertainty Data

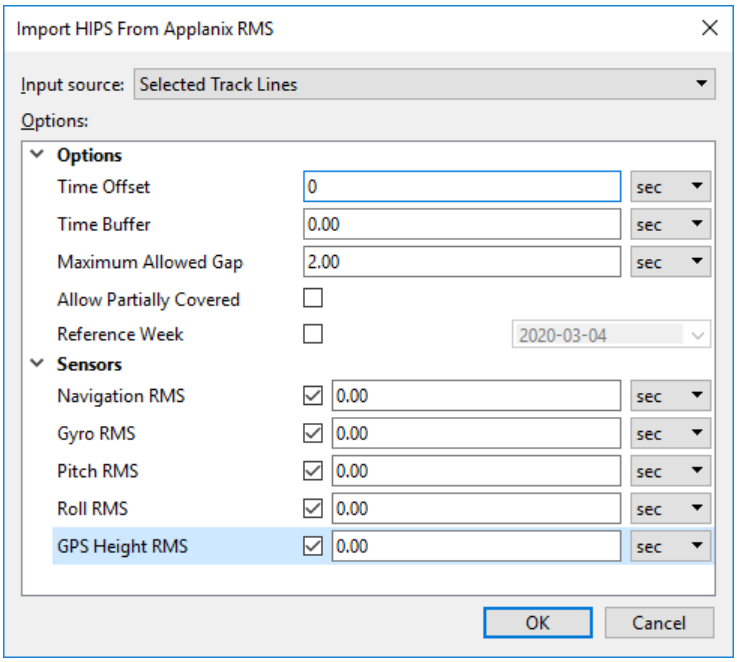
Additional uncertainty data may be loaded separately, to be used in the TPU computation in place of the static HVF values. As mentioned previously, Applanix POS/MV files contain real-time attitude, navigation and RMS uncertainty values recorded during survey.

This means that different uncertainty values are recorded for different conditions, resulting in more precise uncertainty estimates than the static uncertainty values recorded in the HIPS Vessel File.

Exercise 31.

a. On **Layers** window, select the **CUBE Track Lines** layer and within the **Active Track Lines** window highlight the **Track Lines** layer and then select **File > Import > Auxiliary Data > Applanix RMS**.

b. In the **Open** window, go to the directory **…\Preprocess\ CUBE\Applanix\ RMS\2807** and select the file **2011_090_2807.smrmsg** and **2011_091_2807.smrmsg.**



c. It will Open the **Import HIPS From Applanix RMS** window. On **Input source**, choose **Selected Track Lines**.

d. In **Options** leave **2** for **Maximum Allowed Gap**. Then leave all other options at default settings.

e. In **Sensors** enable checkboxes for **Navigation RMS, Gyro RMS, Pitch RMS, Roll RMS** and **GPS Height RMS** and type in **0** for each enabled data type and make sure the units selected are **sec** (seconds) from the drop list.

Note: When a value of zero is entered no down sampling will occur on the generated files and ALL data from the imported data will be utilized.

Choose which records in the Applanix files you want to import into the line by clicking on the appropriate check boxes. Then enter an output interval (in seconds). This value determines how frequently the data is written to the HIPS RMS file.

f. Click **OK**.

Real Time Uncertainty data is Imported but will not be applied until you run Compute TPU process, using the Real Time Uncertainty Data, instead of Vessel Settings.

SVP Editor

SVP Editor is used to create and edit sound velocity profiles that will be used in the sound velocity correction process. It can be opened by clicking on the SVP Editor icon or by selecting the **Tools > Editors > Sound Velocity Profiles** menu option.

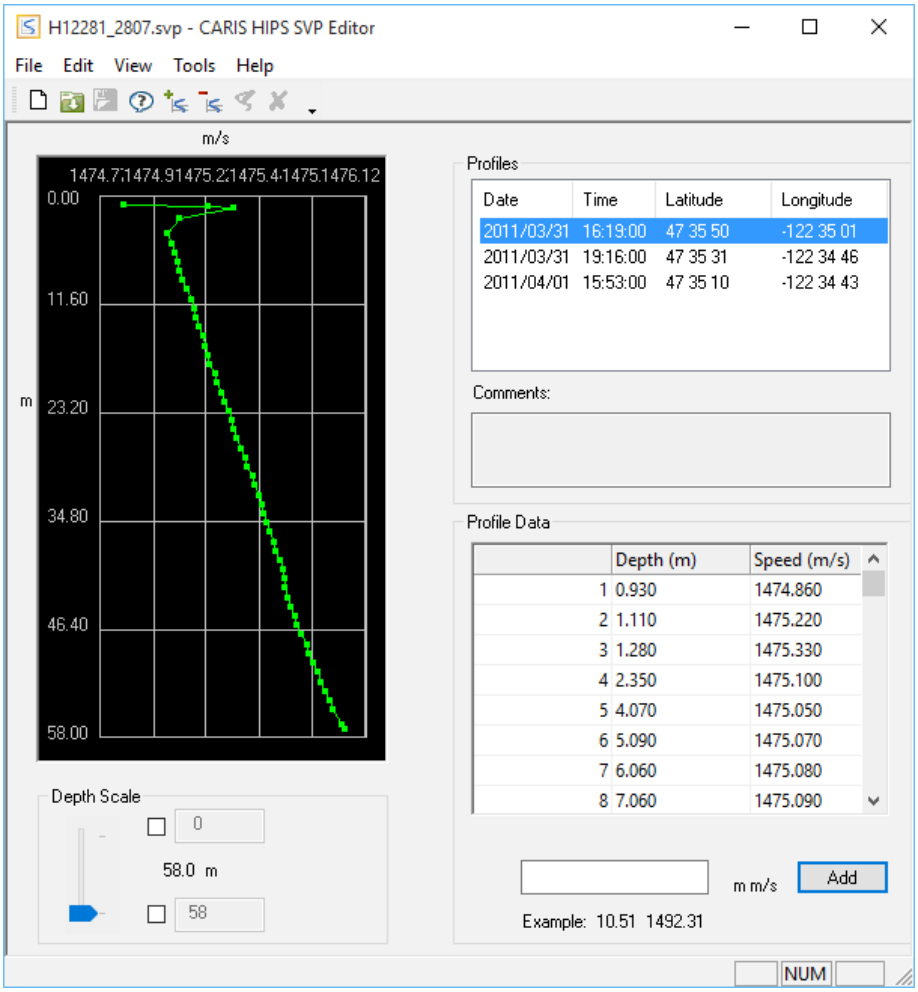
Exercise 32.

a. Click the **SVP Editor** icon or the **Tools > Editors > Sound Velocity Profiles** menu.

b. Click the **Open** icon or in the **File > Open** menu, to open the file **H12281_2807.svp** in the **SVP\CUBE\2807** directory.

There can be a number of profiles in a single file. Each profile must be time-stamped and have a different location specified to differentiate it from other profiles.

- Positions can be added or changed using **Edit > Edit Profile…** 
- New profiles can be added using the **Edit > Add Profile…** menu or by directly editing the text file. 
- Existing profiles can be removed using **Edit > Remove Profile**. 
- Profile Data can be removed by selected from the Profile window and using **Edit > Delete**. 
- Single values inside one profile, can be deleted using **Tools > Delete,** by using the icon **Remove Value** or simply using the key **Delete** from the keyboard 
- **Tools > Options** is used to change the appearance of the **SVP Editor** interface



c. Browse through the different profiles, before exiting the **SVP Editor**.

d. **Do not** save any changes.

e. Go to the menu **File > Exit**.

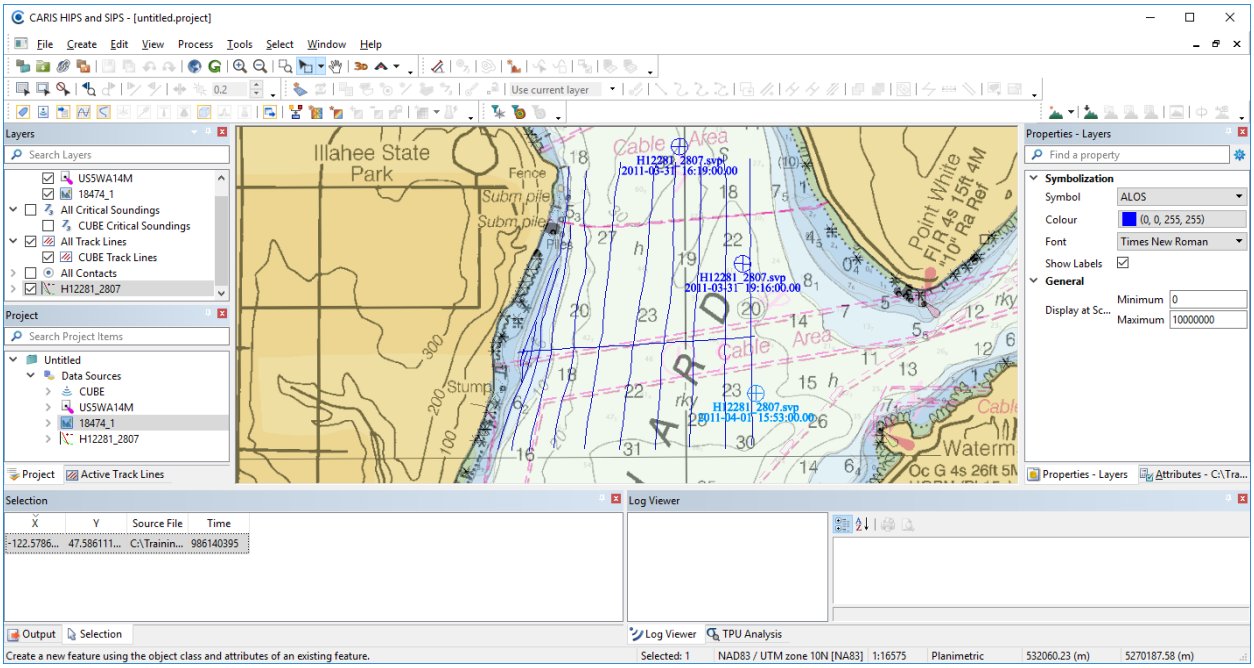
SVP Positions as Background Data

During the course of a survey, several sound velocity casts may be acquired. If the positional information for these casts were recorded, then they can be shown in the Display window.

Exercise 33.

a. Click the **Open** icon to open a svp file or choose the **File > Open...** menu.

b. Select the **H12281_2807.svp** file from the **…\SVP\CUBE\2807** directory, and click Open.



A new layer will appear in the layers window.

c. On the **Layers** window, select the **H12281_2807** layer and in the **Properties** window, change the Symbol Colour to **Blue. Refresh** the screen.

d. Highlight the **H12281_2807** layer and select a few symbols in the Display window. Details will appear in the **Selection** window.

e. Save the project by selecting **File > Save > Save Project…**

Tide Editor

Exercise 34.

a. Click the **Tide Editor** icon, or choose **Tools > Editors > Tide...** from the main menu.

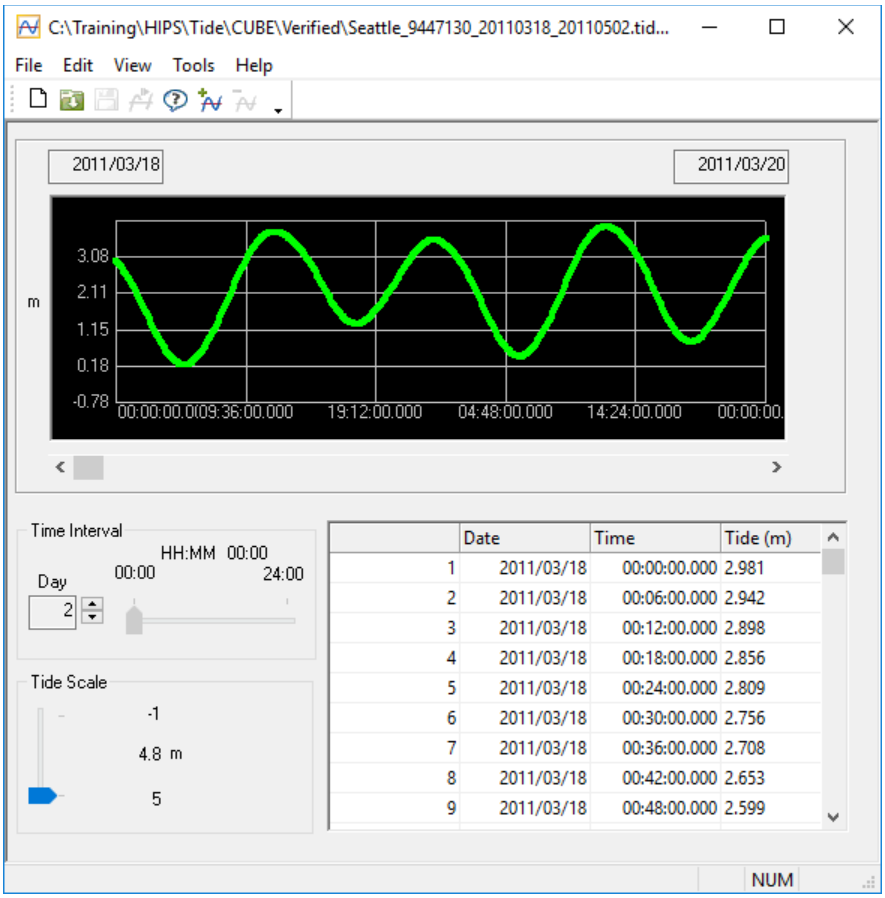
b. Click the **Open** icon or in the **File > Open** menu, to open the file **Seattle_9447130_20110318_20110502.tid** from the **…\Tide\CUBE\Verified** directory.

- New data can be added using the **Edit > Add Tide…** menu
- Existing data can be removed using **Edit > Delete**
- **Tools > Options…** is used to change the appearance of the **Tide Editor** interface

c. Select **Tools > Options**. Enter a **Time Gap value** of **5** minutes, then click **OK**.

d. Click the **Next Time Gap** icon or use the **Tools > Next Time Gap** command, to highlight the first time gaps which exceed the value entered.

e. On **Time Interval** change **Day** to **1** using up arrow. It will automatically display tide information for one complete day. Increasing Day values will show more tide data accordingly.



f. Go to **File > Exit** Tide Editor.

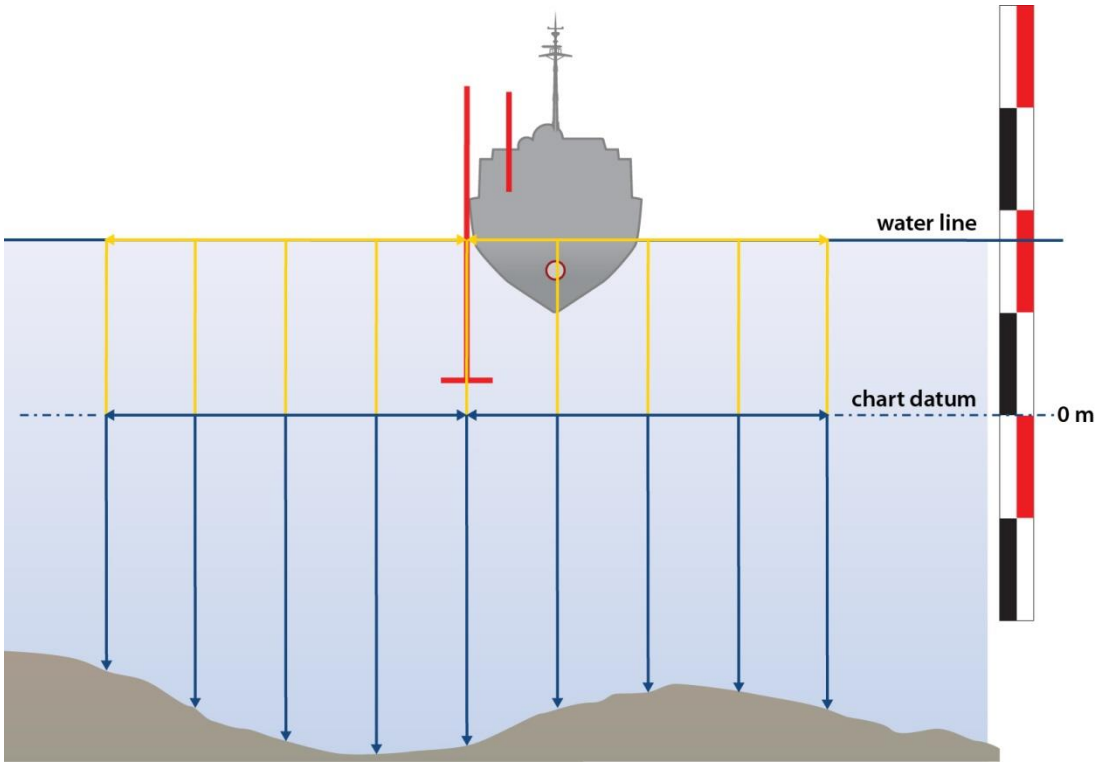
Georeference Bathymetry

With the release of HIPS 11.0, there is a new process called **Georeference Bathymetry**, which in essence Georeference each sounding on the project and these soundings will be referred as processed depths in HIPS.

It also allows executing another three processes optionally; Sound Velocity Correction, Total Propagated Uncertainty and Vertical Datum Reference.

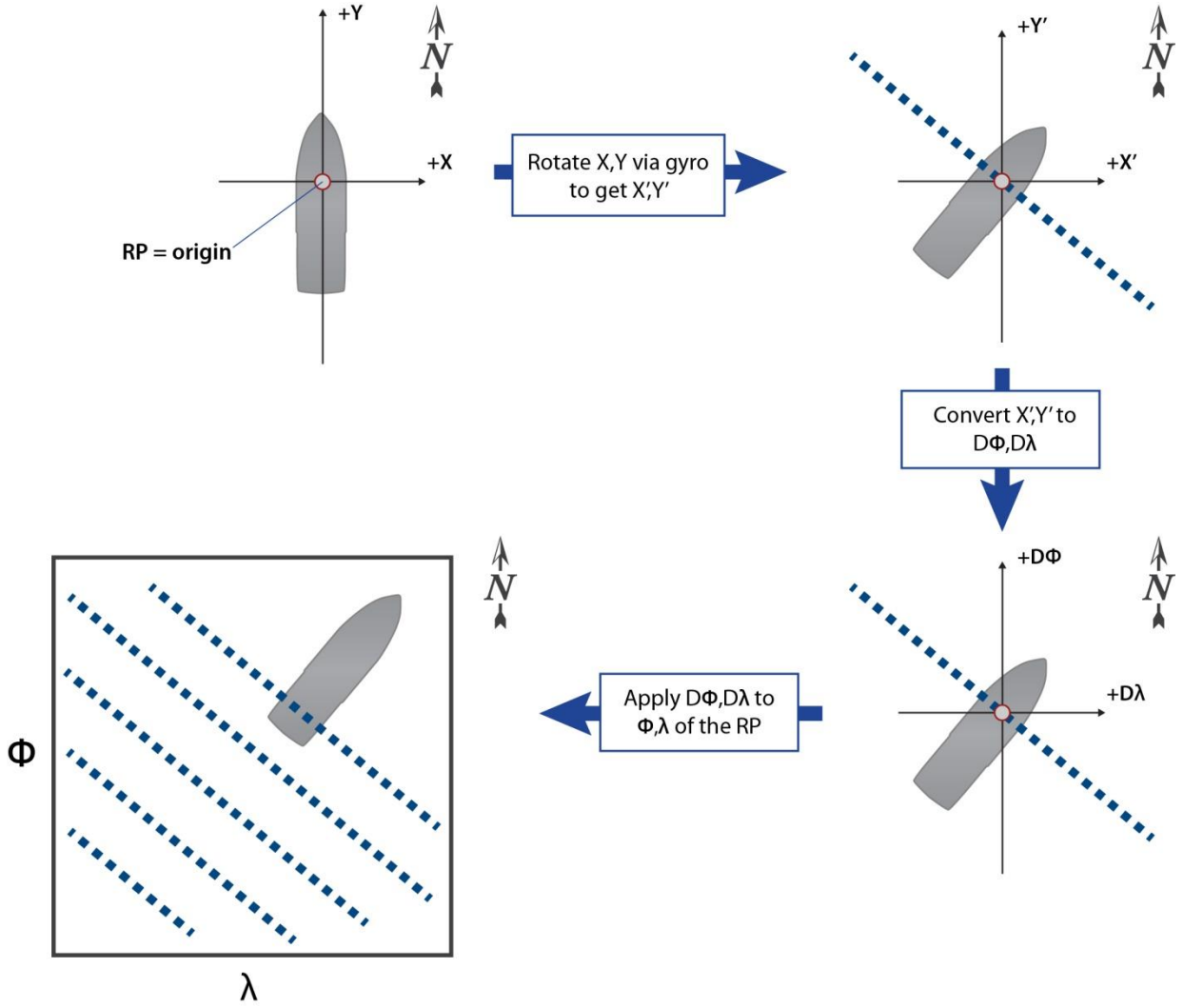
There are two components to the Georeference Bathymetry process: Vertical and Horizontal.

Vertical Component:



- The appropriate tide value (zero tide, loaded tide or computed GPS Tide) is applied to each depth, to produce a final depth that is relative to the chart datum.

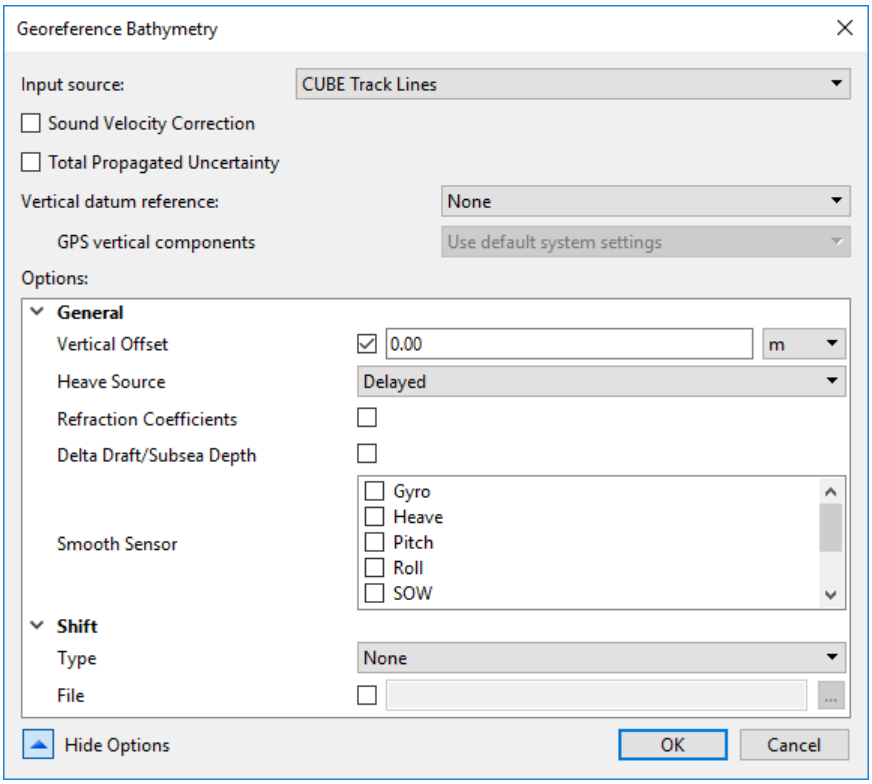
Horizontal Component:



Consider a transducer whose horizontal X, Y position = Reference Position (RP) = Origin.

- The horizontal position for each sounding (X, Y) in each swath is relative to the Reference Position at the time of the ping.
- The gyro observation is interpolated to obtain a gyro reading at the exact time of the ping. The X,Y coordinates for each sounding in the swath are rotated by the interpolated gyro observation.
- The coordinates are then converted to delta Longitude and delta Latitude.
- The geographic coordinates of the RP (Longitude and Latitude) are computed from the geographic coordinates of the GPS antenna (Navigation Data), using the antenna offset information in the HVF, and then interpolated for the exact time of the ping.
- The final geographic coordinate for each sounding in the profile is computed by applying the delta Longitude and delta Latitude to the RP's Longitude and Latitude.

This process is repeated for every swath in each line.



Exercise 35.

a. Click on the **Georeference Bathymetry** icon or select **Tools > HIPS and SIPS > Georeference Bathymetry…** from the menu.

b. On **Input Source** select **CUBE Track lines**.

c. Click on the blue down arrow **Show Options**.

The **Vertical Offset**, allows to introduce a fixed single value offset, to be applied to all soundings.

Delayed Heave and Post Processed **Attitude/Navigation** information has been loaded for these lines. For Heave Source, at this point you have two options; to apply the original recorded Heave (**RealTime**), or to apply the loaded Delayed Heave (**Delayed**). Delayed Heave will be applied to the data and it will be re-ray traced based on the new information.

Refraction coefficients option, the refraction coefficients will be applied, if the coefficients were saved on the lines in Refraction Editor.

If smoothing coefficients are created in **Attitude editor** or **Navigation editor** for the data types listed, you can select to use the **Smooth Sensor** data for the re-computation of the observed depths. You will determine if smoothing coefficients are required during the data quality control portion of this training module.

Also a **Shift** option (a per beam shift to the processed depth solution from a beam look-up table), can be applied on this step.

d. On **Heave Source**, select **Delayed**.

e. Leave all other parameters by default.

Georeference Bathymetry takes into consideration all of the horizontal and vertical offsets in the HVF to produce a processed sounding. Parameters marked with an asterisk ("*") are applied in the SVC process:

- Observed depth
- Navigation
- Gyro
- Vertical datum reference
- Calibration parameters
- Delta draft
- Refraction coefficients
- Motion data (Heave or Delayed Heave, Pitch, and Roll)*
- Waterline*
- Dynamic draft

Sound Velocity Correction

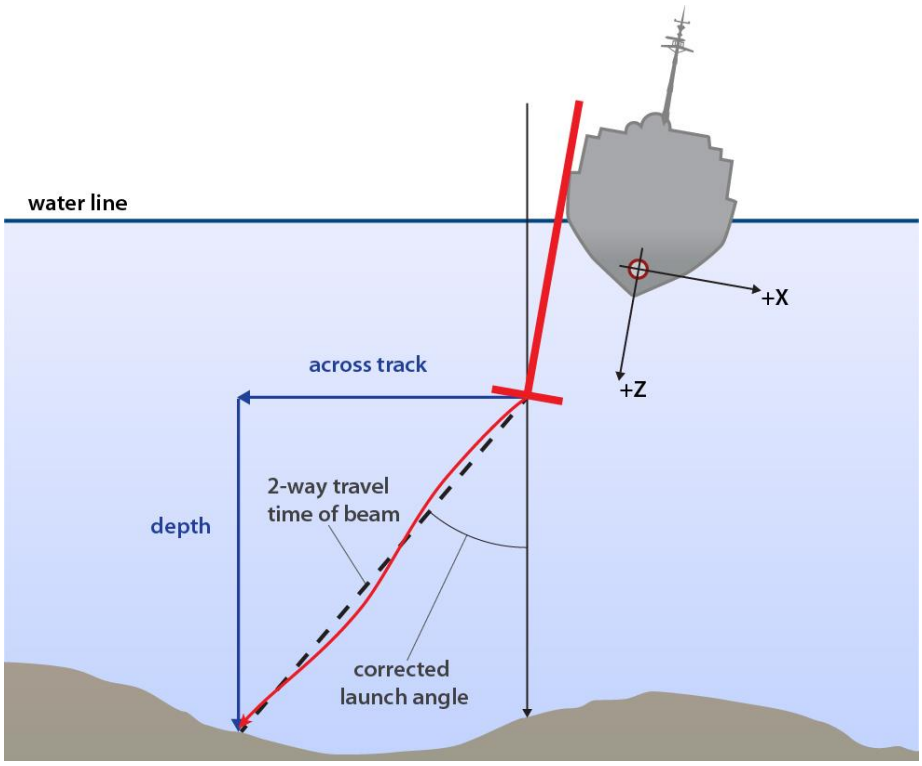
Raw data formats such as **HSX** contain two-way travel time and beam launch angles. Producing a geographically referenced sounding position and depth from this data is a two-stage process.

1. The procedure for calculating the length and path of the sound wave through the water column for each beam is called the Sound Velocity Correction (SVC). The result is an along-track/across-track/depth for each beam.

2. The Georeference Bathymetry converts the along-track/across-track/depths into latitude, longitude, depth by combining the ship navigation with horizontal and vertical offsets in the HIPS vessel file.

f. Check the option **Sound Velocity Correction**. SVC Options will appear on the options window.

The **SVC** algorithm calculates the ray path of the sound wave through the water column for each beam. In order to do this the program needs to know several things:



- Any rotations that have to be applied to the transducer head – both static (i.e., constant parameters) and dynamic (measured by the attitude sensors instantaneously).

- The acoustic velocity along the water column. This information is loaded into the program as a sound velocity profile.

There are different options for applying velocity information to a swath:

- **Previous in time** – This is the method traditionally used by HIPS, which applies the profile taken immediately before the collected swath.

- **Nearest in time** – In this situation HIPS will apply the SVP with the time stamp closest to that of the collected swath.

- **Nearest in distance** – Uses the position attributes of the profile to determine the nearest profile to a given swath.

- **Nearest in distance within time** – Uses the position attributes of the profile to determine the nearest profile to a given swath within a time window which the operator has to enter.

Note: The profile selection methods listed above are made on a swath-by-swath basis and so it is possible to have several SVPs used in the same survey line.

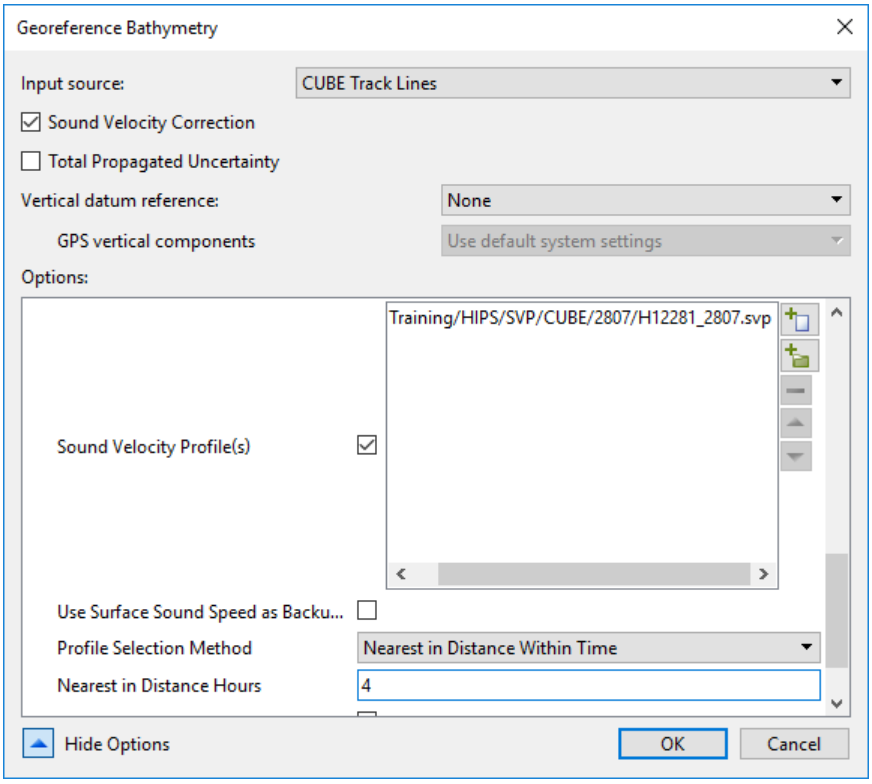
Since release of HIPS 11.0 you can select a folder with all the SVP files and will load all of them, or can load a single SVP file.

Sound Velocity Correction supports some motion-compensated multibeam systems. In these cases, the process checks the HVF to see if the heave, pitch, and roll are set to Apply “No”.

Since release of HIPS 11.2.6, a new option, **Use Surface Sound Speed as backup SVP**, has been added to the Sound Velocity Correction options in Georeference Bathymetry. This option will allow a user to pick up the SSP data in a line to use as a sound velocity profile (SVP) through the water column when the data does not contain any imported or loaded SVP information.

As of HIPS 8.1, the functionality for using available SSP data has changed. SSP information is automatically imported. However, you now have a choice whether to use this information during SVC. If the "**Use Surface Sound Speed**" check box is not checked, SSP will not be added to the profile for SVC.

Additionally, you can choose the option **Steered Beam Angle Recomputation** to interpolate surface sound speed from the available sound velocity profiles (not recommended if the SSP sensor information is available and valid).



g. Active the checkbox **Sound Velocity Profile(s)**. Click on the + icon and select the file **H12281_2807.svp** on the folder **…\Training\HIPS\SVP\CUBE\2807**

h. Leave disabled the option **Use Surface Sound Speed as Backup SVP**

i. On **Profile Selection Method**, select **Nearest in Distance Within Time**.

j. On **Nearest in Distance Hours**, type **4**.

k. Enable the checkbox **Use Surface Sound Speed**.

Total Propagated Uncertainty

By creating an Uncertainty budget for all of the contributing survey sensors, you will be able to take a quality control approach to process the bathymetric data. In the following exercises, you will compute TPU for our sounding data. In later exercises, you will then be able to use this additional attribute information to filter the data and produce surfaces, which are generalized representations of the sounding data.

In order to generate TPU values for each sounding, the definition of uncertainty estimates for each of the contributing sensor, has to be combined using a propagation algorithm. The result is a separate uncertainty estimate for the depth, **DpTPU** and horizontal position of the sounding, **HzTPU**. The results are presented at the 95% confidence interval, which is equivalent to 1.96 x the standard deviation.

$$\sigma_D = \sqrt{\sigma_d^2 + \sigma_{D_H}^2 + \sigma_{D_D}^2 + \sigma_{D_W}^2} \quad \ldots$$

Reduced Depth Uncertainty
Dp TPU

$$\sigma_{p_{Final}} = \sqrt{\sigma_p^2 + \sigma_{p_a}^2 + \sigma_{p_t}^2} \quad \ldots$$

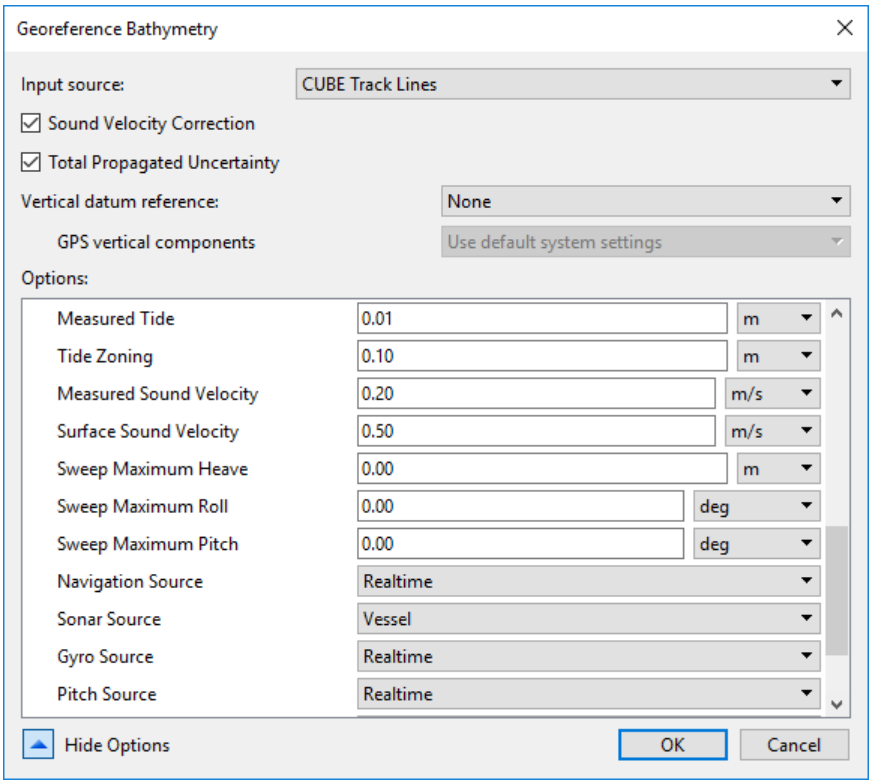
Total Positioning Uncertainty
Hz TPU

l. Check the option **Total Propagated Uncertainty**. TPU Options will appear on the options window.

Equipment utilized for tide and/or sound velocity measurements may vary from survey to survey. Therefore, the values defined under Survey specific parameters are not in the HVF. The Sweep specific parameters should be defined if calculating TPU for a sweep survey without motion sensor information.

The TPU values will be computed based on the Observed depths, therefore tide and draught offsets will not affect the values. The uncertainty values are presented at 2 sigma (95% CI), as are IHO survey accuracy requirements.

The TPU values will be calculated for the soundings based on the Real Time Uncertainty data loaded from Applanix and the sonar device model. If real time sonar uncertainty was collected during acquisition, this sonar real time uncertainty would have been used instead of the device model (when choosing Uncertainty Source - 'Realtime). For these data there was no real time sonar uncertainty information so HIPS will use vessel file values instead.



m. On **Measured Tide**, type **0.01 (m)**.

n. On **Tide Zoning**, type **0.1 (m)**.

o. On **Measured Sound Velocity** enter **0.2 (m/s)**.

p. On **Surface Sound Velocity** enter **0.5 (m/s)**.

q. Select these sources:
Navigation Source: Realtime
Sonar Source: Vessel
Gyro Source: Realtime
Pitch Source: Realtime
Roll Source: Realtime
Heave Source: Delayed
Tide Source: Static

It is a sensible idea to get a feel for maximum and minimum values for the dataset. It is important to understand that the TPU values have been calculated with no knowledge of what is a good or bad sounding. A spike may have better TPU values than a good sounding, simply because it is

closer to the transducer head than the real seabed, i.e. the propagated uncertainty will be less in shallow water, since it increases as a factor of water depth and distance from nadir.

The information about TPU magnitude will be useful when making decisions about filtering the data later in this training exercise. The maximum Horizontal TPU for the data will be required in the creation of Product surfaces later in the workflow.

Note: for this data, the uncertainty values using the Real Time Uncertainty data are much lower than the uncertainty values using the vessel settings. This means our TPU values in the vessel file are pessimistic with respect to the actual observed values.

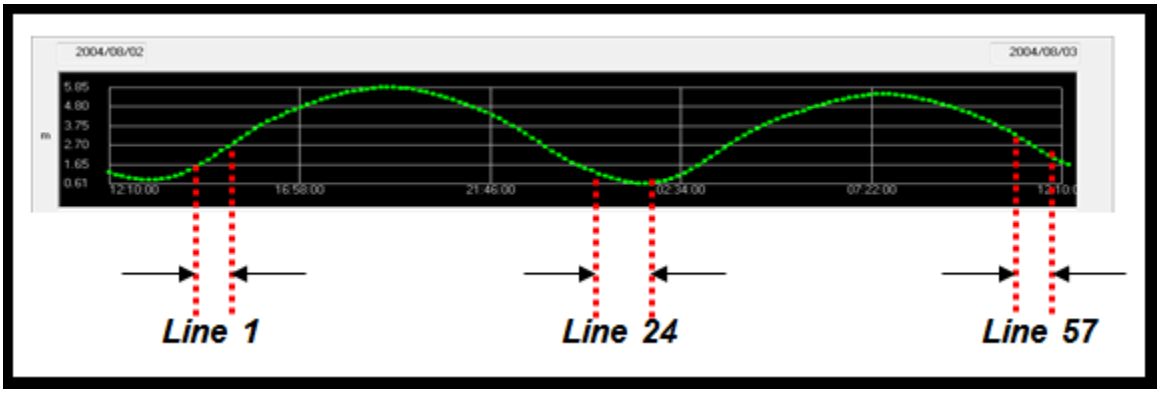
Vertical Datum Reference

You can choose from three different Tide Options from the Tide drop list in Georeference Bathymetry:

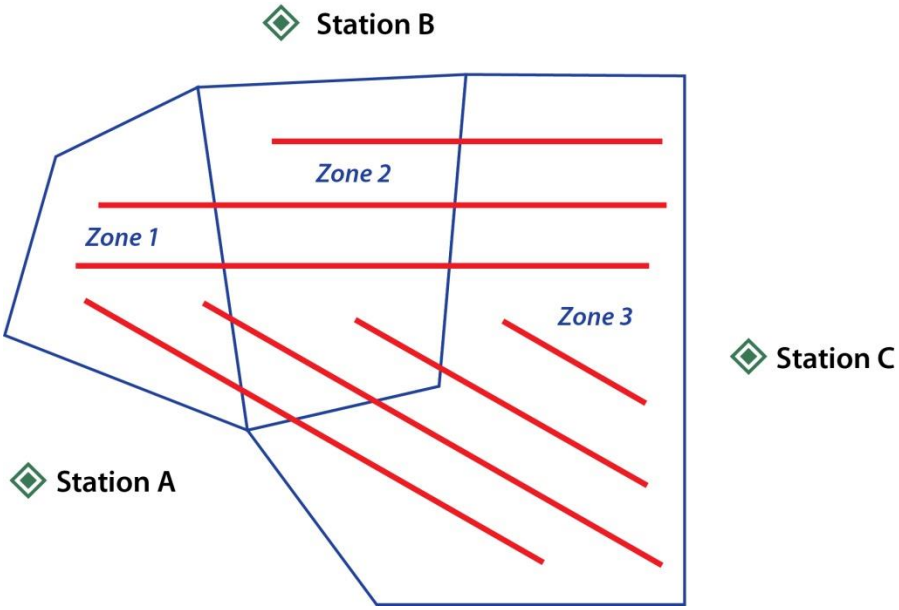
None: With this option, no tidal correction will be applied (Zero Tide). This is the default setting.
Tide: Options for Observed tidal corrections will be displayed.
GPS: Options for GPS tidal corrections will be displayed.

Observed tidal corrections involves applying data collected from tide stations and optionally using zones, which cover the survey area.

- The tide data from a single tide station can be applied to each survey line as a whole.



- Tide data from multiple tide stations can be compiled. The tide data is loaded for each part of a line as determined by the zone the part falls into.



To define a tide zone several parameters are required:

- Zone boundary in geographic coordinates
- The location of the primary tide station
- Locations of up to 3 optional alternative tide stations
- Time offset in minutes for each station
- Range offset / tide scalar for each station (e.g., 1.01)
- Outage limit in minutes, controls when data will be extracted from secondary stations
- Interpolation interval in seconds for final interpolated tide loaded into each survey line data structure.

Note: Loaded tide data can be viewed and filtered using Attitude Editor.

When using data from multiple stations, a weighted average of tidal observations along the survey line can be generated. This only works if information about the tide stations is given in the tide zone file. The weight given to the tide data is inversely proportional to the distance between the station and the swath data, which is why the zone definition file should include latitude and longitude positions for tide stations.

Note: The tide weighting formula can be expressed as the following:

$$Ti = \frac{\sum(Wx * tx)}{\sum Wx}$$

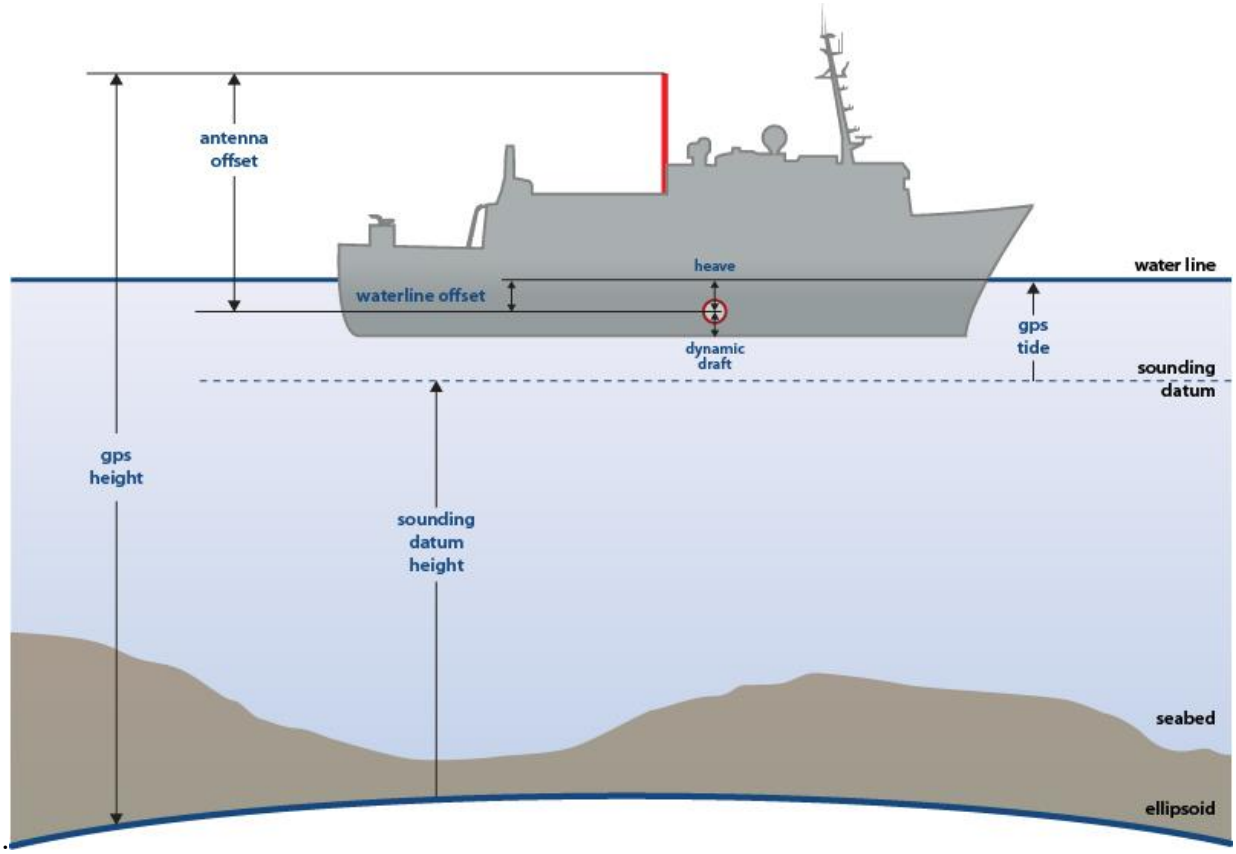
$$Wx = 1/dx$$

Ti = The tide value for the ith profile along the line
tx = The tide value from the xth tide station for the time and location of the ith profile
Wx = The weight of the tide value coming from the xth tide station
dx = The distance between the ith profile along the line and the xth tide station.

The tide observations will be loaded to the survey lines based on time stamps. The vertical datum will be applied, so that our observed depths can be reduced to the working chart datum.

r. On **Vertical datum reference**, select **Tide** from the drop list. **Tidal Observations** Options will appear on the options window.

The GPS Tide relative to the chart datum is derived from the GPS Height relative to the ellipsoid, and the conversion between them involves a separation model.



The sounding datum can be either a single height applied to all the soundings or a separation model that defines the difference between the collected ellipsoid height reference and the chart datum. If a separation model file is used, it can be either:

- an ASCII (.xyz) format file with an .info file that will control the parsing of the ASCII data, or
- a gridded binary (.bin) file.

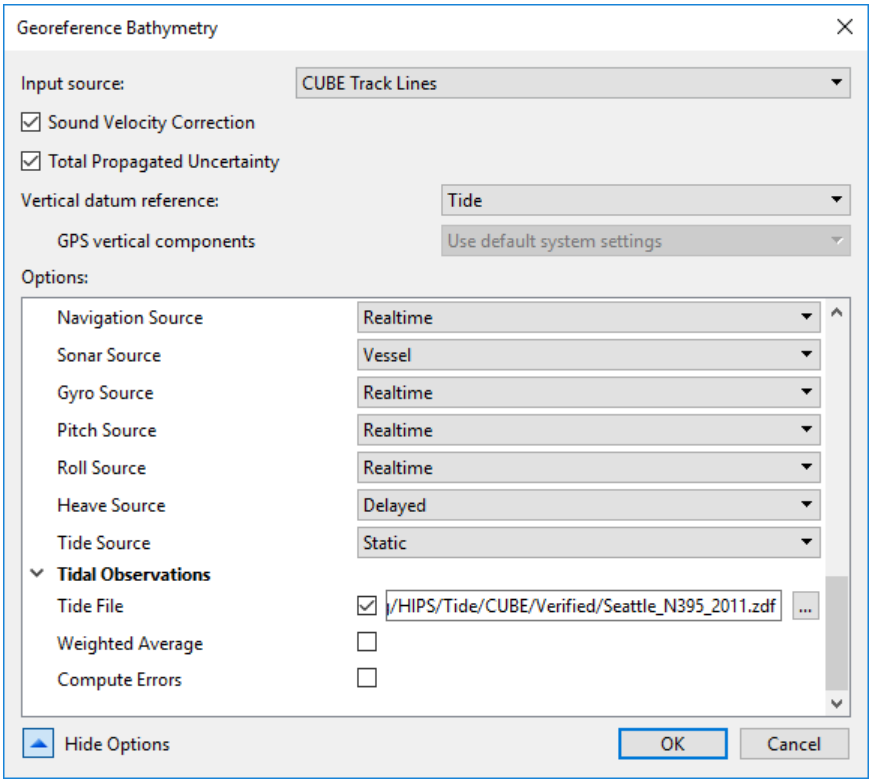
Also, as of version 8.0.3, any open surface layer or TIN layer can be selected as the input "model" for computing GPS tide.

If no separation model is used, and a single height of 0.0 is applied, the resulting depths will be referenced to the navigation ellipsoid.

GPS Tide can be used as a direct replacement for traditional tide data. The vessel configuration is used as normal with respect to transducer offsets, calibration values, application of heave, pitch, and roll, etc.

Since release of HIPS 11.2.6, a new option called **GPS vertical components** has been added to the Georeference Bathymetry process. It is used when 'Vertical datum reference' is set to GPS. There are two options: 'Use default system settings' and 'Use custom settings'. The default settings option will automatically process the GPS Vertical Adjustment, as it has since the 11.0.0 release. The custom settings option requires a user to determine what is applied in the GPS Vertical Adjustment, similar to versions previous to 11.0.0.

For Hypack raw data, GPS Height information is contained in the *.RAW files. These must be supplied with the *.HSX file (of the same name) in order for GPS Height information to be imported.



s. Active the Checkbox Tide File and select the file **Seattle_N395_2011.zdf** on the folder **…\Training\HIPS\Tide\CUBE\Verified**.

t. Click **OK.**

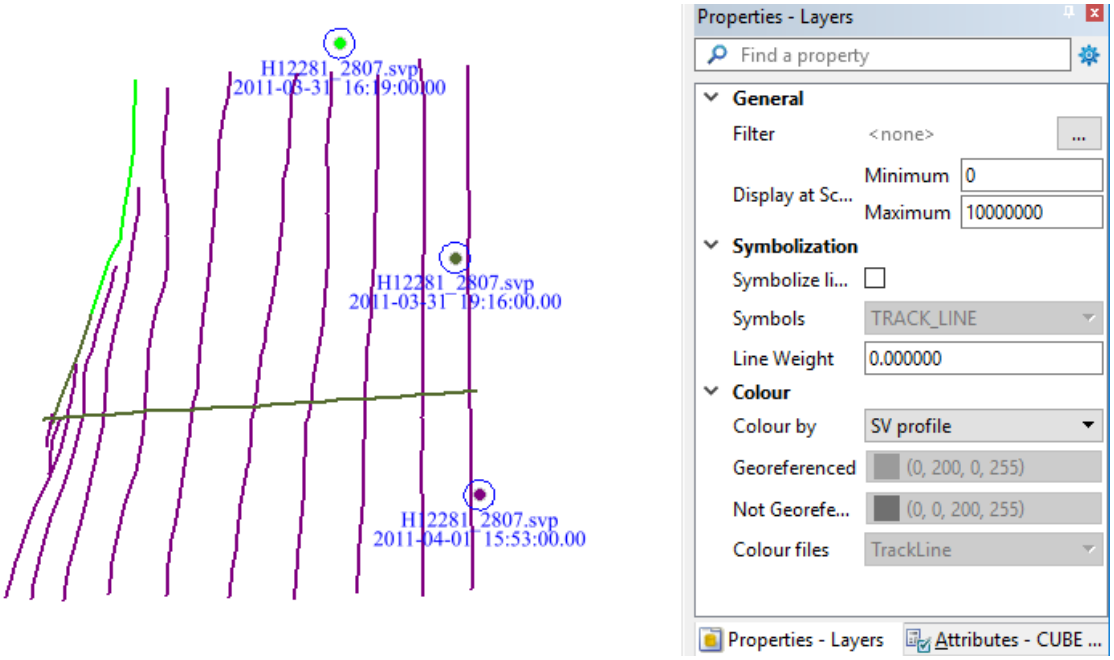
The survey lines will change colour in the display window indicating they are Georeferenced, when 'Colour by' "State" has been selected for the Ship Track Lines Properties window.

Applied SV Profile

If SVC is applied to a line using HIPS 7.1 Service Pack 1 or later, an index of the applied profiles is stored with each line. This index can be used to colour lines in the display based on which SV Profile was applied to each line swath.

Exercise 36.

a. Select the **All Track Lines** layer in the **Layers** window.



b. In the **Properties** window, select **SV Profile** from the **Colour by** dropdown menu.

Lines in the display window will be coloured based on the applied SV Profile. Depending on the density of the SV Profiles and the Selection method used, lines may be made up of multiple SV Profiles. In this case, a single SV Profile applies to each line, depending on their time of survey. The position of the original SV casts is also displayed as colour-coded points in the display.

c. In the **Properties** window, select **State** from the **Colour by** dropdown menu.

Surface Creation

You can now use the sounding data and the associated uncertainty values to create a gridded surface to represent the survey data, or add the new lines to the existent one. A gridded surface can only be created after the soundings are georeferenced. The CARIS surface is a gridded representation of the Georeferenced Bathymetry data, created using various gridding algorithms.

The following exercises will explain how surfaces are created and updated using the gridded CUBE and Variable Resolution techniques.

Storage Technology

The CARIS storage framework, called CSAR (for **C**ARIS **S**patial **AR**chive), in HIPS and SIPS is a portable file format for the storage of terabytes of data, along with associated metadata.

This framework gives you the advantages of:

- Enhanced storage and management of large volumes of multi-dimensional data.
- Efficient retrieval of data from files and/or database storage devices, including:
  - Retrieving and loading data
  - Caching data in memory
  - Writing modifications back to storage device

Single Resolution Surfaces

HIPS supports the ability to create four different types of Single Resolution surfaces:

- Swath Angle
- Shoalest Depth True Position
- Uncertainty
- CUBE (Combined Uncertainty and Bathymetry Estimator)

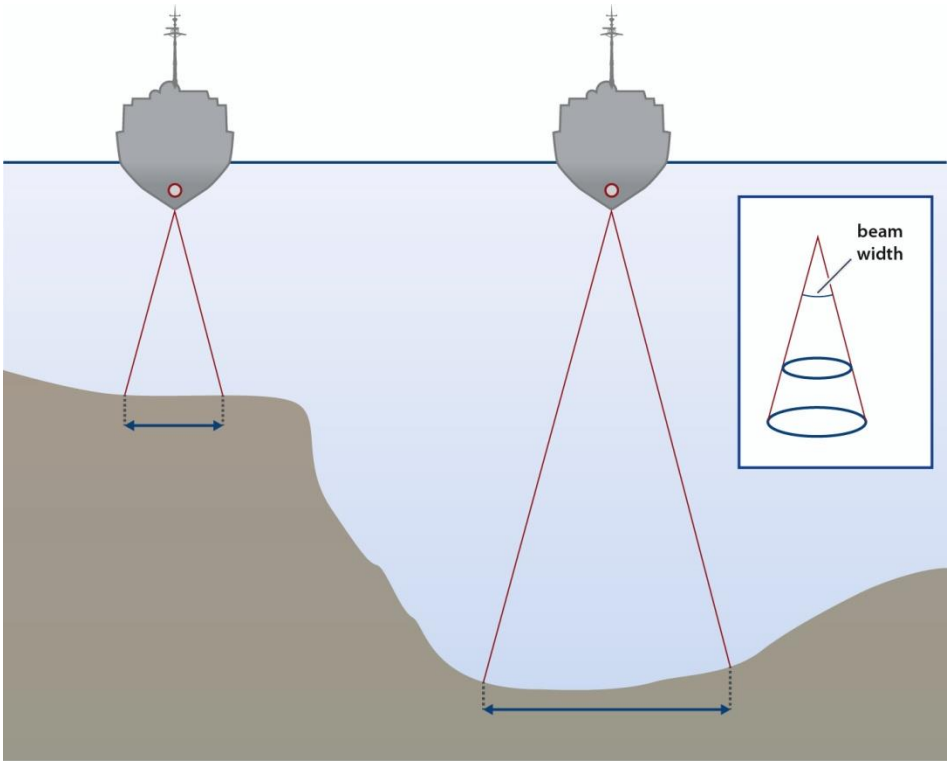
Through the Surface wizard you can select which type will be created. The surface types use different weighting algorithms or selections to produce grids of the sonar data. All four surface types will produce a smooth surface that retains the sonar resolution. You also have the ability to preserve shoal or critical values.

The CUBE surface is also a powerful, semi-automated cleaning tool that can be used to increase processing efficiency. Both Swath and Uncertainty surfaces can also be used for cleaning to some degree.

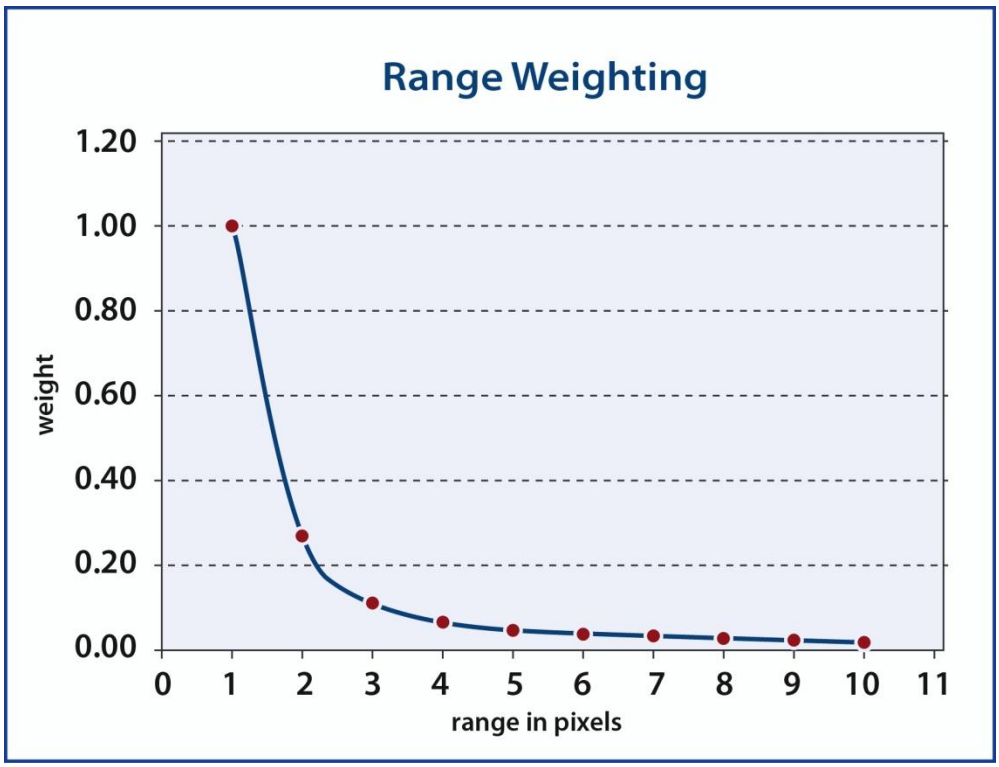
Swath Angle Surface

The Swath Angle surface is a rasterization method specifically designed for multibeam data. It is an accurate representation of multibeam data because it considers the actual geometry of the sonar system. It does this in three ways:

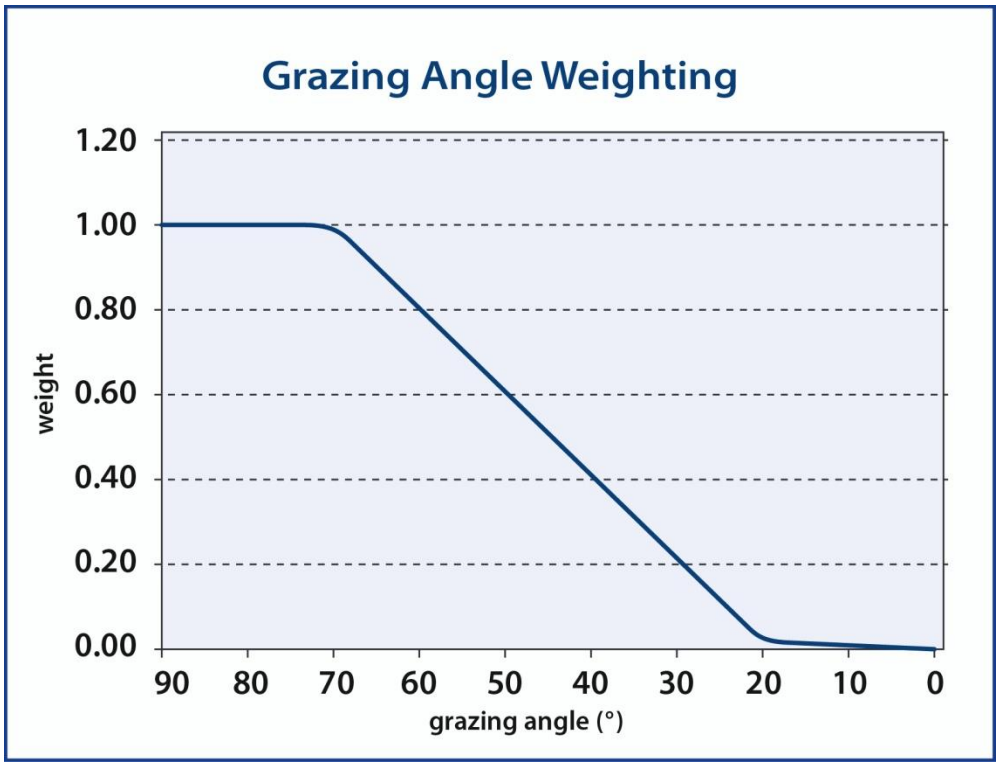
- **Variable radius of influence weighting**- The weighting is inversely proportional of radius of influence of each sounding, which is calculated from the beam width of the selected sonar, and increases with depth and decreases with the grazing angle. This addresses the increase in footprint size with distance from the sonar head.



- **Range weighting** - The range weighting for each sounding decreases with distance from a node. This lessens the effect that soundings further away from the node will have on the surface. The number of nodes each sounding is applied to is determined by the size of the beam footprint. The beam footprint is calculated using depth, sonar beam width, and the grazing angle.



- **Grazing angle weighting** - Errors in multibeam data tend to increase in magnitude in the outer beams due to the longer ray path distances. This tends to magnify refraction problems and other errors. The grazing angle weight function is applied to each sounding to reduce the effects of the outer beam soundings on the surface.



This weight function is controlled in an ASCII file called **grazingangleweights.txt** in the System directory. This file can be modified by you.

The swath angle surface can provide the following layers:

Required:

- **Depth:** The weighted depth based on the above considerations

Optional:

- **Density:** Creates an attribute layer that displays the number of soundings used at the grid node
- **Mean:** Creates an attribute layer that displays the arithmetic mean of all depths used to determine the weighted depth
- **Standard Deviation:** Creates an attribute layer that displays the standard deviation of all the depth data used at the node from the mean.
- **Shoal:** Creates an attribute layer that displays the shoalest sounding contributing to a node, represented at the grid node location
- **Deep**: Creates an attribute layer that displays the deepest sounding contributing to a node, represented at the grid node location

Shoalest Depth True Position

The Shoalest Depth True Position surface most closely resembles a binning technique, where the bin size is defined as the resolution. This surface stores the shoalest depth within a given node in the depth layer

The Shoalest Depth True Position surface can provide the following layers:

Required:

- **Depth:** The shoalest depth value within the bin with its original position.

Optional:

- **Density:** Creates an attribute layer that displays the number of soundings used at the grid node
- **Mean:** Creates an attribute layer that displays the arithmetic mean of all depths used to determine the weighted depth
- **Standard Deviation:** Creates an attribute layer that displays the standard deviation of all the depth data used at the node from the mean.
- **Deep**: Creates an attribute layer that displays the deepest sounding contributing to a node, represented at the grid node location
- **Median:** Creates an attribute layer that displays the median values of soundings contributing to the node.
- **Horizontal TPU:** Creates an attribute layer that displays Horizontal TPU value of the shoalest sounding
- **Vertical TPU:** Creates an attribute layer that displays Vertical TPU value of the shoalest sounding.

If Horizontal and Vertical Uncertainty do not exist for the lines selected, the surface creation will continue without these attributes. If, at a later time, uncertainty data becomes available, a surface recomputation can be applied and the surface will be updated accordingly.

Uncertainty Surface

The horizontal TPU (HzTPU) and depth TPU (DpTPU) values are used in the creation of an Uncertainty surface.

When creating an Uncertainty surface each sounding value will have an associated depth and horizontal uncertainties. The depth uncertainty that each sounding has, increases with the horizontal distance from the surface nodes. Therefore, the greater the distance, the greater the uncertainty, and the less the sounding will contribute to the node.

The area of influence is a radius that determines the number of nodes to which the sounding can be applied. This radius is determined by the maximum allowable depth uncertainty of the selected IHO S-44 Order. An important point is that the stricter the IHO order chosen, the smaller the radius of influence of that sounding. Also, a sounding will only contribute to a node as long as its vertical uncertainty does not exceed the maximum allowable vertical uncertainty as specified by the IHO order selected.

IHO S-44 (5th Ed.) Standards for Horizontal and Depth Uncertainties

Order	Special	1a	1b	2
Description of areas.	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but *features* of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Maximum allowable THU 95% *Confidence level*	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Maximum allowable TVU 95% *Confidence level*	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013	a = 1.0 metre b = 0.023

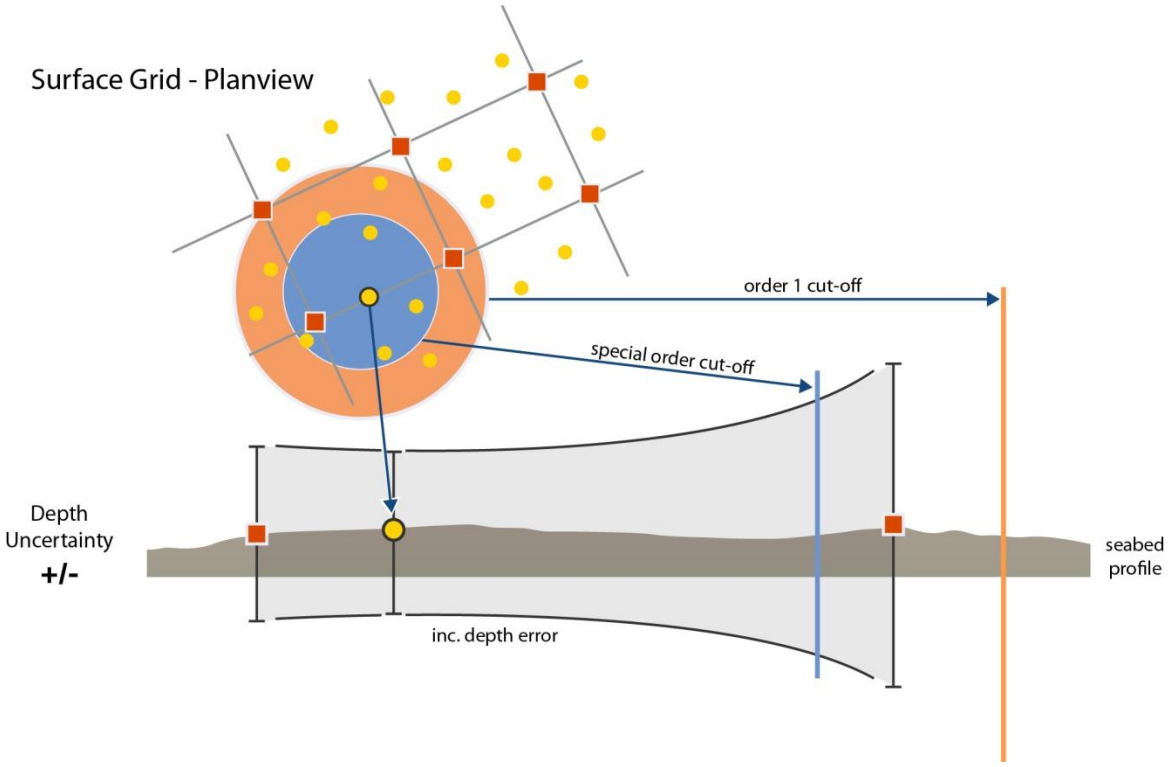
CUBE Surface

The CUBE (Combined Uncertainty and Bathymetry Estimator) surface can be used as a cleaning tool in the HIPS workflow, as an end product or as a tool in product creation.

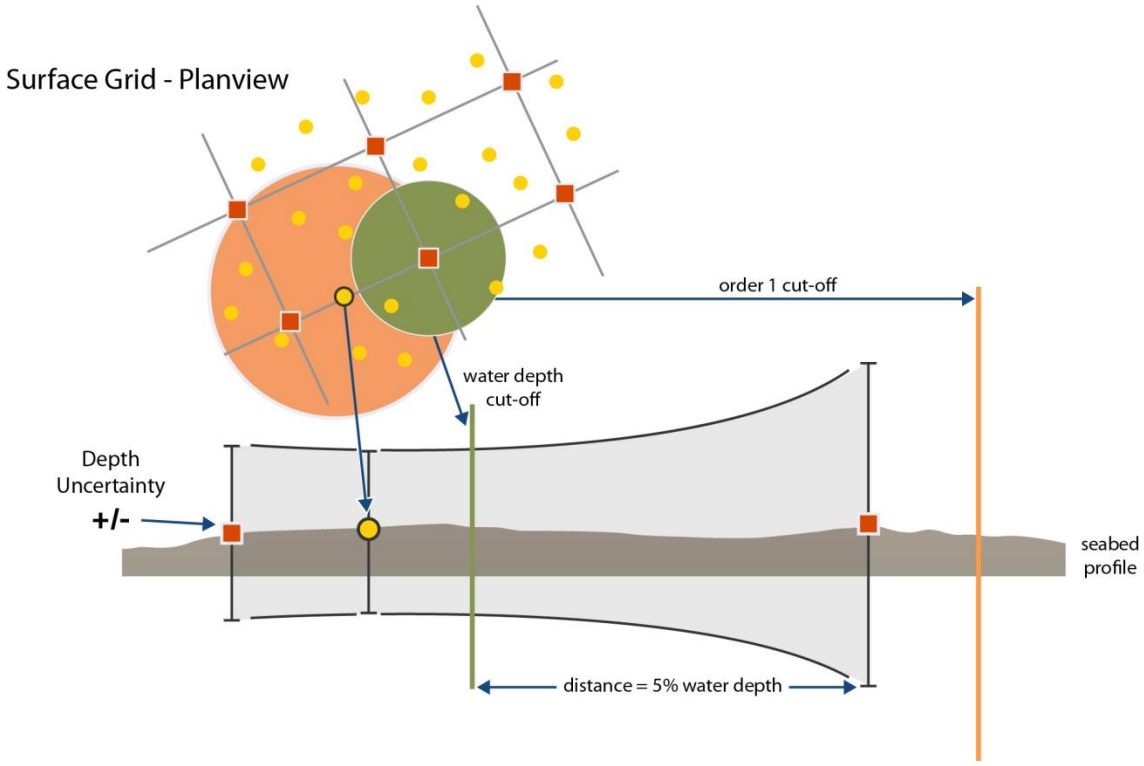
During the CUBE surface creation, soundings are weighted and contribute to surface grid nodes based on TPU values and distance from the nodes. The weighting method is similar to the Uncertainty surface creation.

The CUBE surface however, allows for multiple depth estimates or hypotheses to exist at each grid node, depending on the variation of the sounding data. CUBE then uses "Disambiguation" to determine which hypothesis at each node is the most "correct".

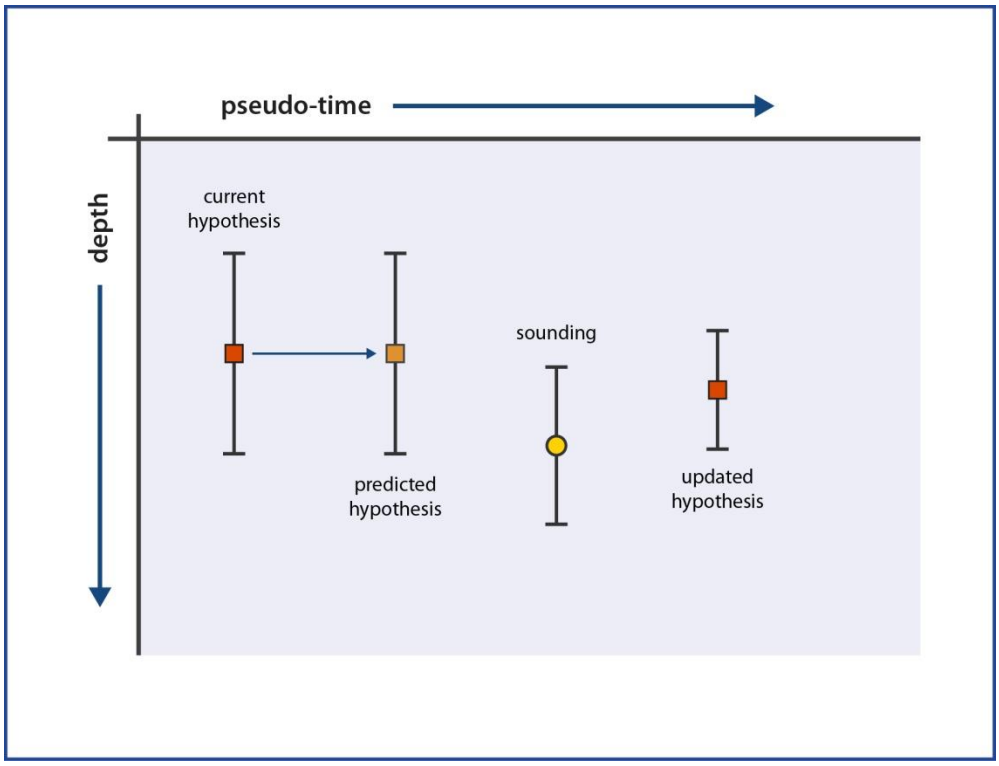
You can verify, and if necessary override, CUBE decisions in Subset Editor. Once any necessary edits have been made to the CUBE surface, the Surface Filter can be applied to the data. Any sounding data that is not in agreement with the selected hypotheses will be flagged as rejected via the Surface Filter.



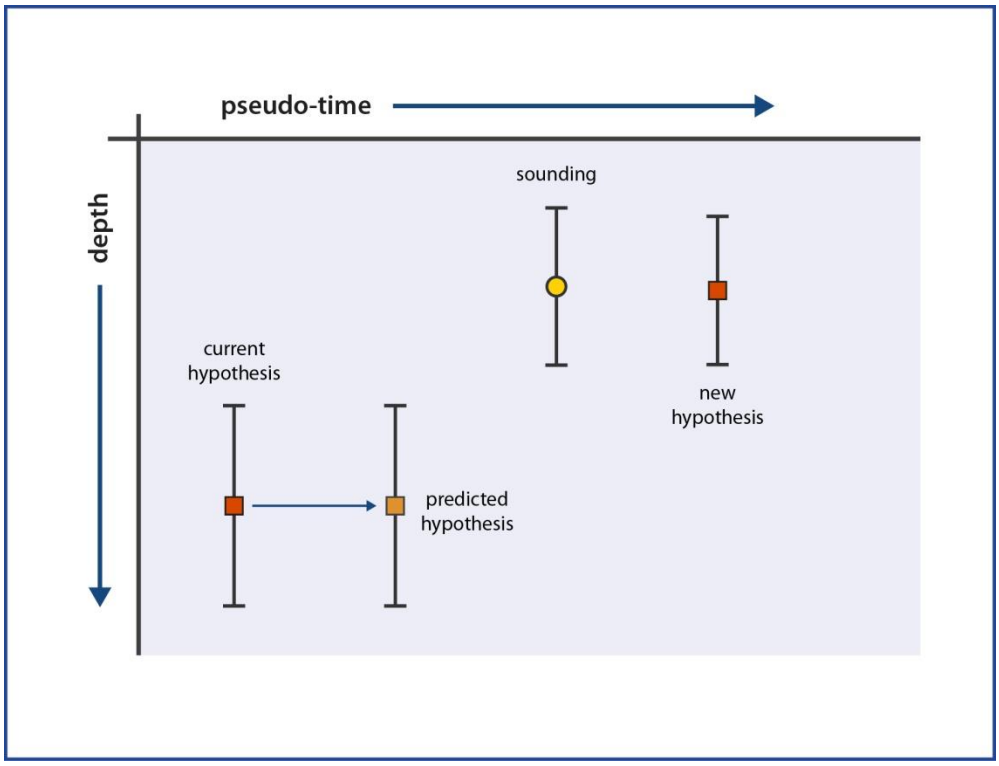
As shown above, the initial uncertainty of the sounding (yellow circle) continues to propagate as the distance from the sounding position increases. As long as the depth uncertainty does not propagate beyond the specified vertical accuracy cut-off (Special Order, Order 1a, etc.) the sounding will be considered for contribution to the depth estimation of the grid node (orange square).



However, a percentage of the sounding's water depth is also used to limit the area of influence, as shown above. If the horizontal distance between the sounding and the grid node exceeds a set percentage of the sounding's depth (5% by default), it will not contribute to the node. This dynamic will override the IHO cut-off.



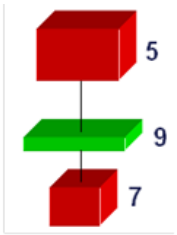
The CUBE surface allows for multiple depth estimations, or hypotheses, to be maintained at each grid node, and so determining which soundings will contribute to the nodes is only one component of the surface creation. The number of hypotheses at each node will be dependent upon the depths and vertical uncertainties of the contributing data, and their vertical distribution. Like the soundings, once a hypothesis is initialized, it too will have an associated vertical uncertainty. The Hypothesis Update illustration above displays current Hypotheses, which represent the most recent depth estimations. The updated hypotheses represent the same depth estimations, but at a point in time when more data is incorporated into CUBE.



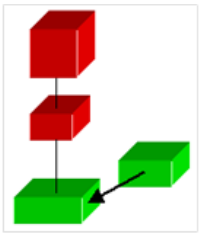
An input sounding will contribute to the current hypothesis when it is close enough physically and stochastically to the current hypothesis estimate, otherwise, the input sounding will generate a new hypothesis at that grid node, as shown above. As more and more soundings contribute to a particular estimation, the uncertainty of that hypothesis will decrease, indicating a more certain estimation. If the soundings are widely distributed in the water column, they will generate many hypotheses.

Once all hypotheses at all nodes have been computed there are several methods available for CUBE to determine which hypotheses will be selected.

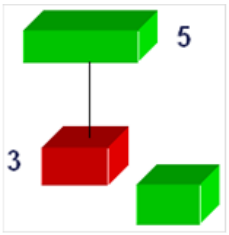
There are three disambiguation methods as illustrated below:



Density



Locale



Density and Locale

Density: The hypothesis that had the most soundings contribute to it will be selected as the correct estimation.

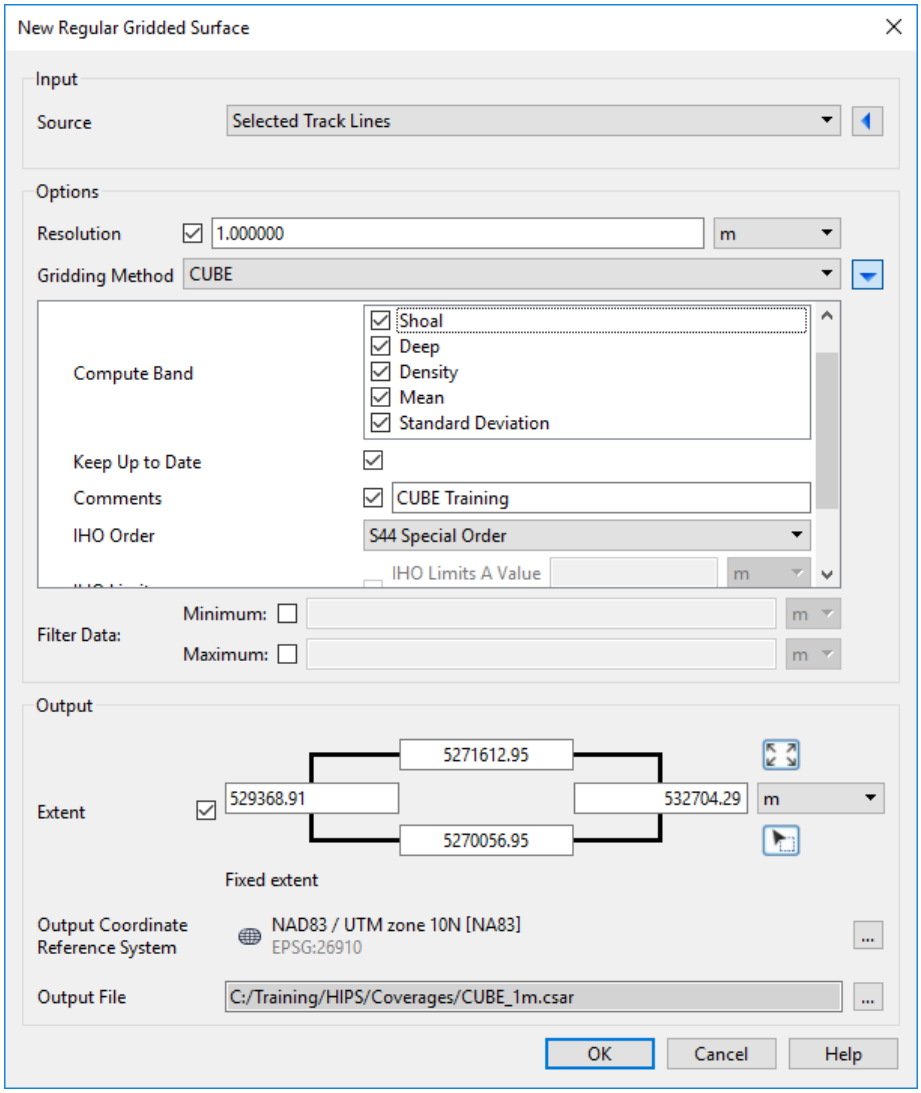
Locale: The hypothesis that is closest in agreement with the trimmed mean of the neighbouring nodes (i.e. that have strength values less than the specified maximum) will be chosen.

Density and Locale: This is a combination of the two previously mentioned methods. If the strength value of the hypothesis selected by Density is less than the specified maximum, that hypothesis will be used in the CUBE surface. If the strength value exceeds the maximum, Locale will be used to select the hypothesis.

Before generating a CUBE surface, all lines to be included must be Georeferenced with TPU computed.

Exercise 37.

a. Within the **Active Tracklines Window** select **Track Lines** layer, then click the **New Regular Gridded Surface** icon, or **Tools > Coverages > Grid > Single Resolution Surface…** option from the main menu.



b. In the **New Regular Gridded Surface** check the **Input > Source** is **Selected HIPS Track Lines** and click on the arrow icon on the right to unfold the options.

c. On **Options > Resolution** enable the checkbox and enter a value of **1** m

Since the release of HIPS 11.0, Gridded Surface creation allows you to select **Resolution** as **Automatic**, which will let the software finds the biggest separation across and along track of all soundings and using it as the (coarsest) resolution.

d. On **Options > Gridding Method** select **CUBE** from the drop list and click on the arrow icon on the right to unfold the options.

The disambiguation method will determine the method CUBE will use to determine the most likely bathymetry estimates. In this case it will use density, but if it is not confident in a selection it will switch to the locale method instead.

The Advanced Options tab enables you to select or define the parameters to be used for the CUBE surface creation. There are several pre-configured parameter sets available for selection. The configuration selection should be made based on the water depths and the complexity of the seafloor in the survey area.

Note: Only experienced users should adjust or define the CUBE parameters. It is also possible for CUBE to use an Initialization surface to ensure that grossly erroneous soundings will not be utilized in the CUBE surface creation. The CUBE surface will be visible in the display window and the surface child layers, which are created by default, will be added to the Layers window.

e. On **Options > Gridding Method (CUBE) > Options** check the following was selected:
   - **Compute Band: Shoal, Deep, Density, Mean** and **Standard Deviation** enabled.
   - **Keep Up to Date:** enabled
   - Enable checkbox **Comments** and enter the comment **CUBE Training**.
   - **IHO Order: S-44 Special Order**
   - **Disambiguation Method: Density and Locale**
   - Leave the **Vertical Datum** set to **Unknown**

The current display extents can be used (by default) to generate the surface extents. It is possible to pan and zoom when defining the surface extents with the **Use Screen Extents** icon.

In addition, you can draw a different sub-area with the **Pick from Screen icon**, or simply introducing new coordinates on the **Extent** Boxes (West, South, North and East).

Since the release of HIPS 11.2, you can use the option **Automatic expand extent to data**, this eliminates the need to define the extents of a coverage using the Create HIPS Grid and Create SIPS Mosaic processes, either through the application interface, process models or CARIS Batch. Having the extents of the CSAR automatically update is particularly useful when surveying an area with uncertain final extents; as new areas are surveyed, the extents of the CSAR will automatically update to include the new data and not require a new coverage each time data is imported. This also means the Overview command will use the current extents of the data and not the predefined extents in the coverage; reducing the need to zoom in after applying Overview to coverages that anticipate more data to be added.
No functional changes are expected for the existing CSAR support when the extents are set to fixed. When expanding extents are used, previous versions of the software will not be able to open the data. The **File > Save As...** functionality can be used to create a new CSAR that is compatible with previous versions.

f. On **Output > Extent**, leave checked the check box, having the **Fixed extent** populated from the screen.

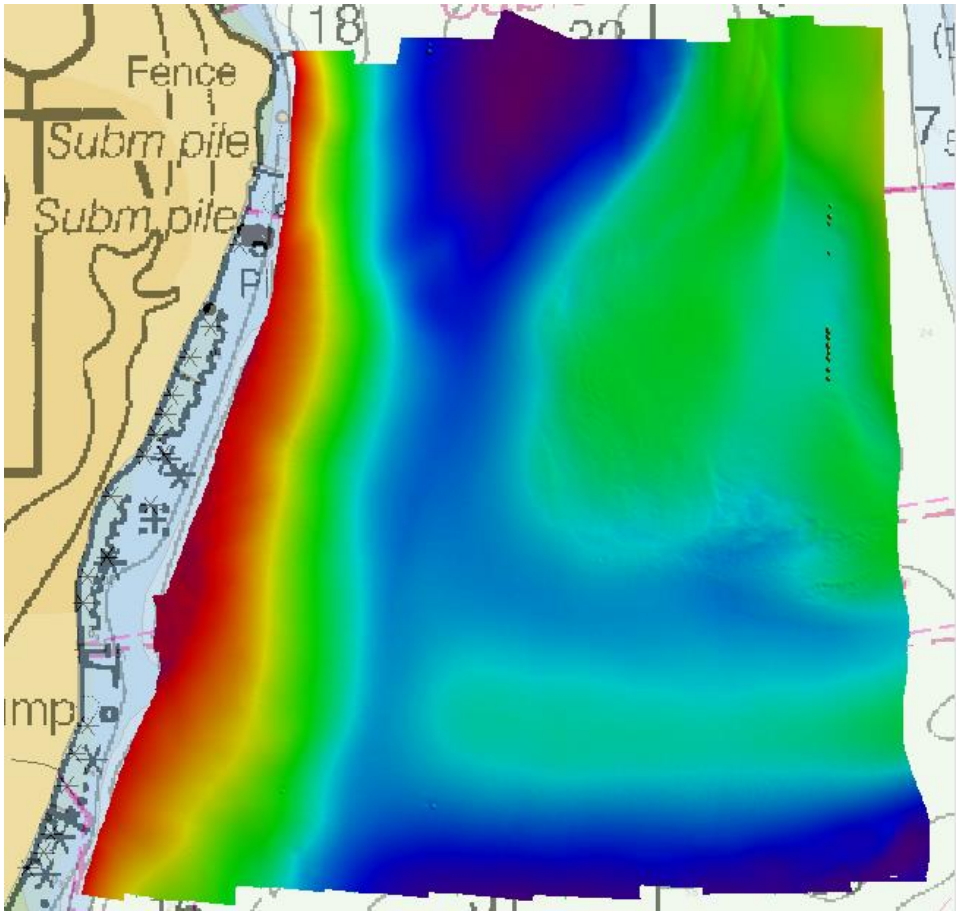
The **Output Coordinate Reference System** is chosen by default from the current view projection in HIPS.

g. On **Output > Output Coordinate Reference System** leave the coordinate system to **NAD83 / UTM Zone 10N [NA83] (EPSG:26910)**

Finally, the user needs to select a Surface name and location in **Output File**.

h. On **Output > Output File** click the **…** option to give a name and location for the resulting surface. Save it as **CUBE_1m** in **…\Coverages** folder.

i. Click **OK**.

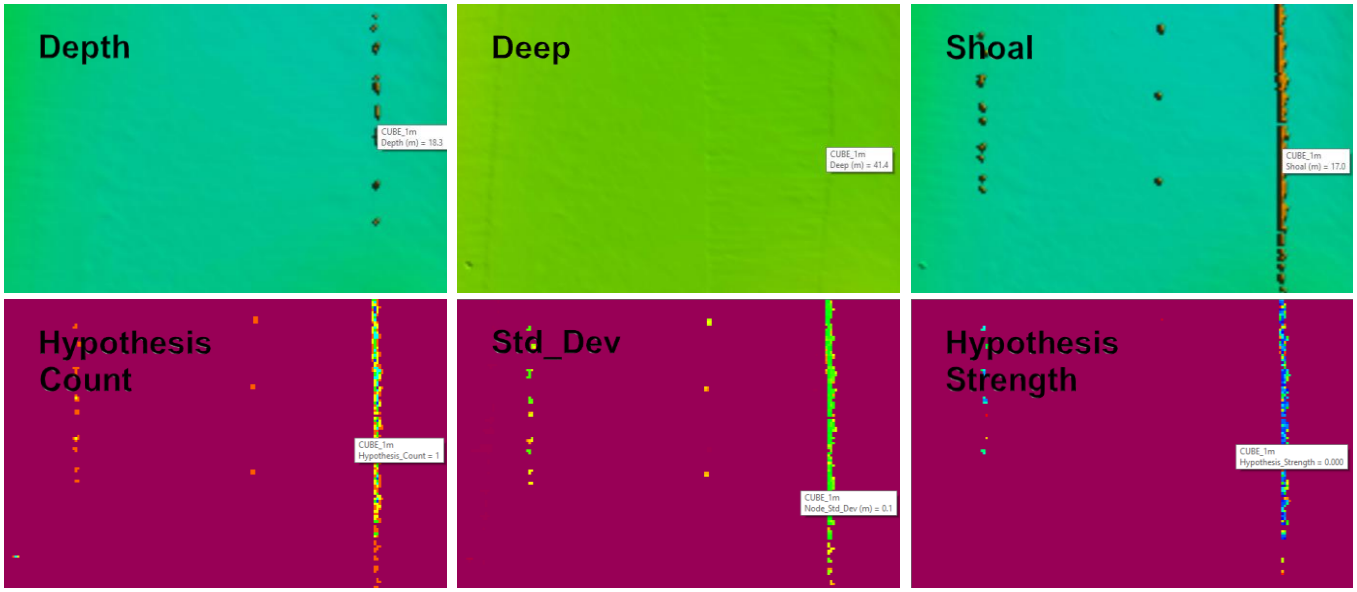


CUBE Surface Bands

The CUBE surface contains the following Bands:

- **Deep**: The deepest sounding of the node.

- **Density**: The number of soundings that contributed to the selected hypothesis.
- **Depth**: The depth estimation of the selected hypothesis.
- **Hypothesis Count**: The number of different depth estimations at the surface node.
- **Hypothesis Strength**: A value to describe how mathematically confident CUBE is that the correct hypothesis was selected during disambiguation. Like Uncertainty, lower values are better.
- **Mean**: The mean of the soundings that contributed to the selected hypothesis.
- **Node Standard Deviation**: The computed standard deviation of the soundings belonging to all possible hypotheses in a specific node.
- **Shoal**: The shallowest sounding of the node.
- **Standard Deviation**: The computed standard deviation of the soundings that contributed to the selected CUBE hypothesis.
- **Uncertainty**: The vertical uncertainty associated with the selected hypothesis. Lower uncertainties are better.
- **User Nominated**: This layer indicates if the hydrographer has nominated a hypothesis during hypothesis editing. This process will be explained further in a later exercise.



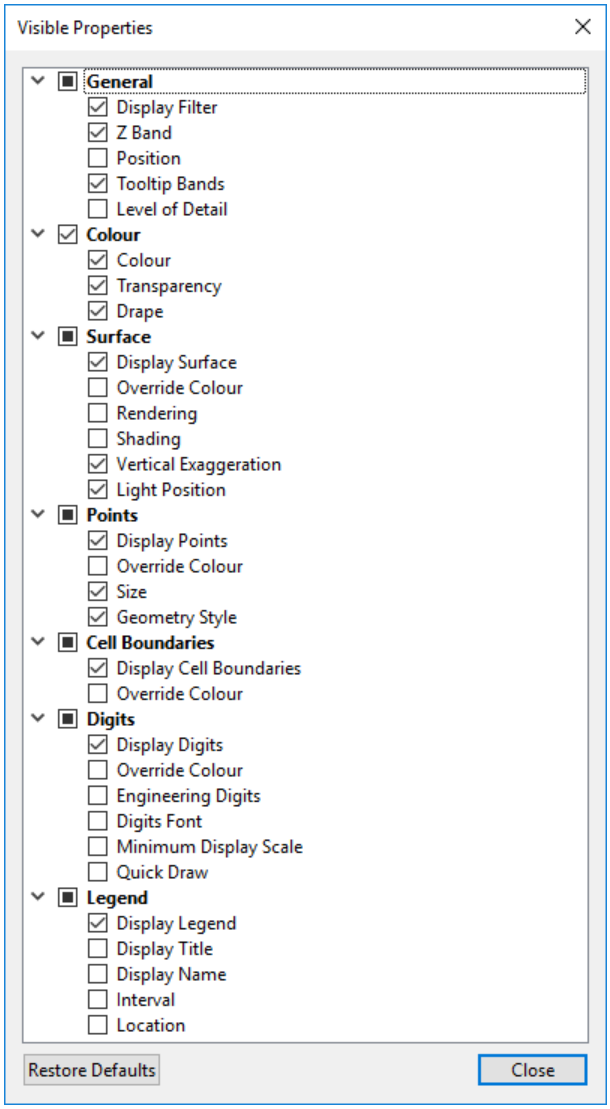
CUBE Surface Properties

The CUBE surface can be shaded to assist in feature recognition. Shading and other image manipulation tools are found in the Properties window. This window can be used to manipulate the display of the various layers listed in the Layers window.

Exercise 38.

a. Highlight the layer **CUBE_1m** on the **Layers** window.

b. Properties can be searched for within the **Properties** window, type **Colour** into the **Find a property** bar. Only the Properties with “Colour” will be visible. Click the **X** symbol there to return to all properties visible.



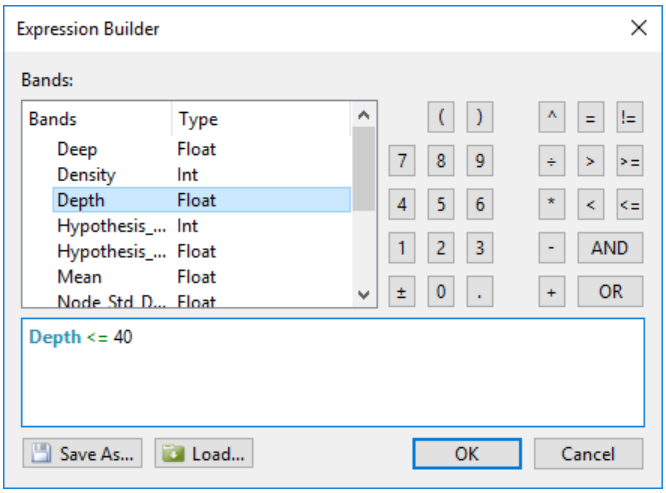
c. Now, click the **blue cog** near the top right corner of the **Properties** window.

d. Enable the **Z band** property under **General**. Click **Close**.

The following can be accessed when a surface layer is selected:

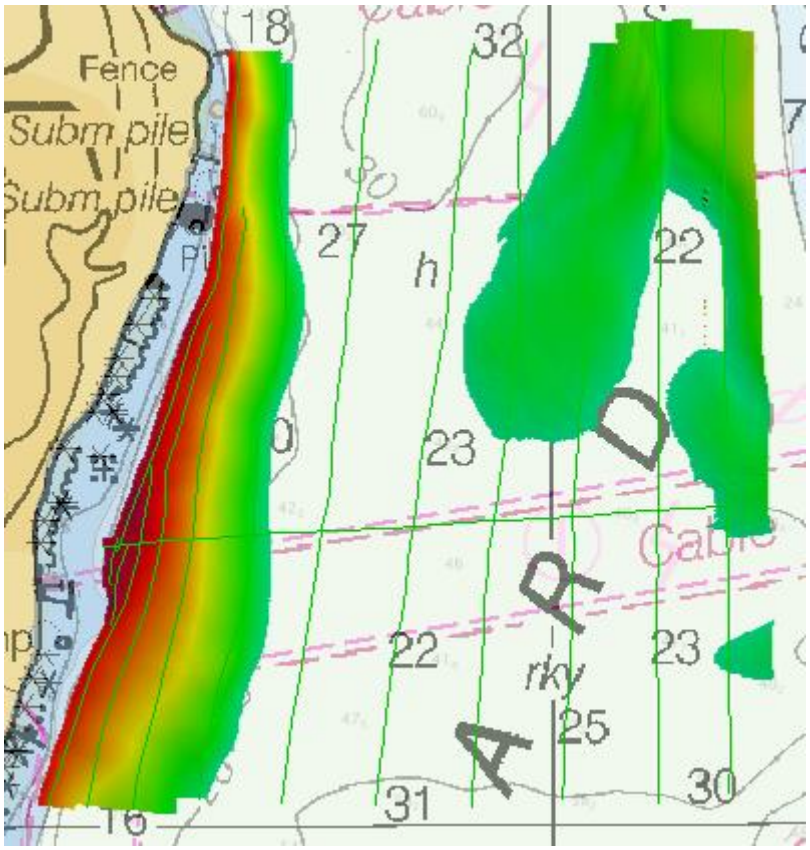
General

Display Filter: – Filter the display of surface nodes by specifying a mathematical expression on a specific Band. Only Band values that are within the specified range will be displayed.



e. Click on the browse option (**…**) on **Display Filter**, this will launch the **Expression Builder** window.

f. Double click on the **Depth** band, this will add **Depth** to the expression. Click on less than or equal to (**<=**) symbol. Then type **40**. Click **OK**.



Now the CUBE Surface is visually filtered with all depths shoalest or equal to 40 meters.

g. Click on the browse option (**…**) on **Display Filter**, this will launch the **Expression Builder** window and delete the expression, then click **OK**.

Z Band: – Displays the main Digital Elevation Model to be coloured or draped for any of the raster bands.

Tooltip Band – When the cursor is moved over the surface, a tool tip shows the value for the nearest surface node (Z Band 'Depth' layer by default). The user can select how many bands are showing on the Tool tip.

h. On the **Properties** window, under **General**, on **Tooltip Band** drop list, select some bands to be shown in the tooltip main display. Move the cursor over the surface to see the information on each node.

Colours

Colour By – Controls the current band is shown on the main display.

i. On the **Properties** window, under **Colour**, set **Colour by** to **Hypothesis Count**.

It will show the number of Hypothesis on the Surface. All areas with Purple colour have just one hypothesis, all other areas with different colours, have more than one.

j. On the **Properties** window, under **Colour**, set **Colour by** to **Depth**.

Colour Map – Controls the display of images using **Maps** (colours defined by pixel values) or **Ranges** (colours defined by surface values).

The colour maps and colour ranges can be created by selecting **<New Colour Range…>** and **<New Colour Map…>**

In addition, the current used map or colour can be edited by clicking **<Edit…>**

k. On the **Properties** window, under **Colour**, set **Colour File** to **Desert [Map]**

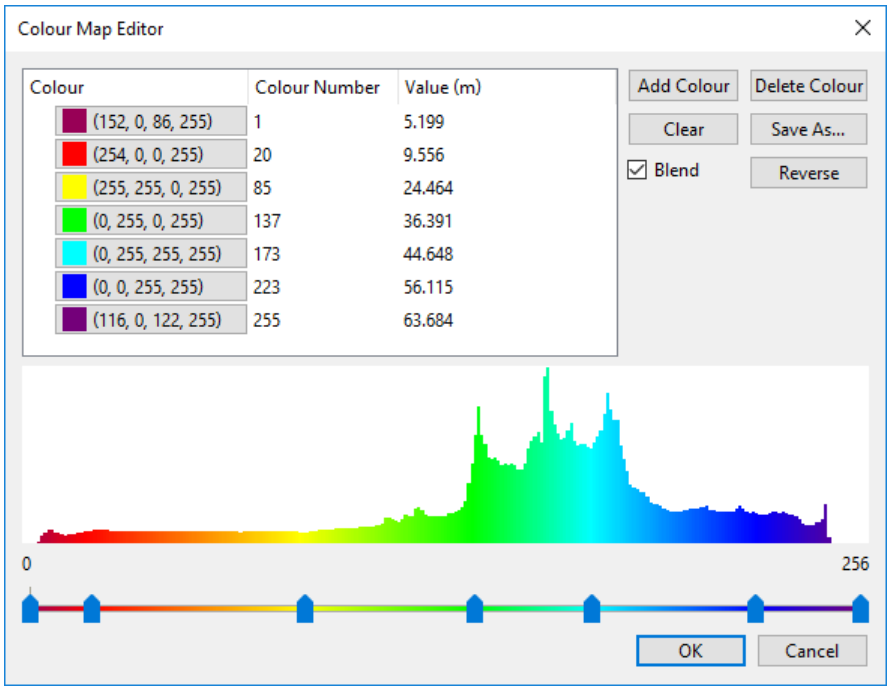
l. Return to the **Rainbow [Map]** colour.

You can manipulate existing colour maps or create your own with the Colour Map Editor. It is sometimes necessary to manipulate colour to obtain the optimal display for a surface.

The properties for that layer, including colour display, will be displayed in the Properties window. The Rainbow colour map is always assigned to the layer by default.

m. On **Colour File** under **Colour** Select **<Edit…>**

The colour map is based on an 8-bit system, which means the colour scale can have a maximum of 256 divisions. The Colour Map Editor allows to change any values on the colour map



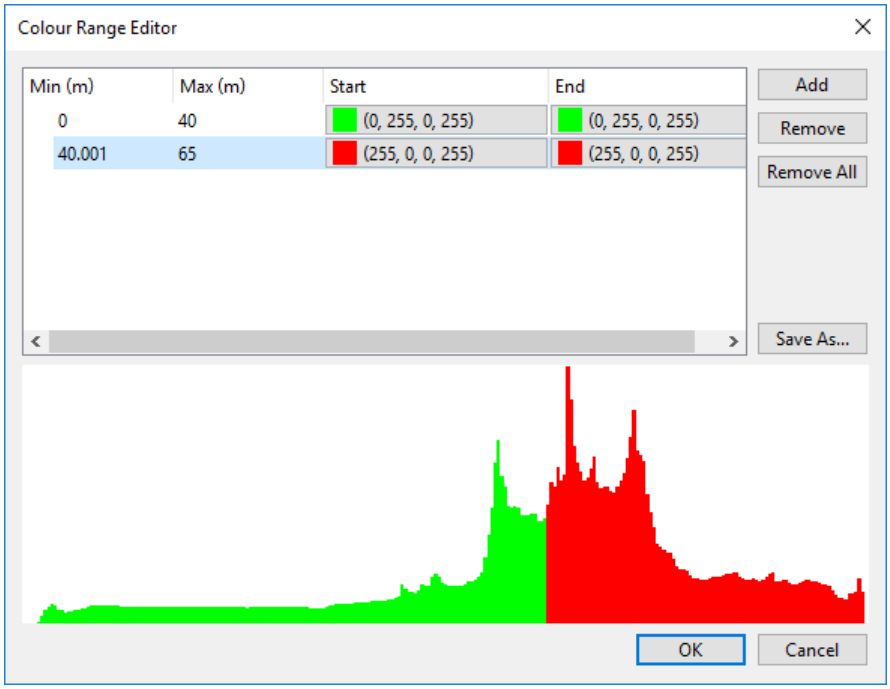
n. Change the colour map **Values** so that they are grouped around the histogram.

This can be done by moving the position indicators under the histogram or by double-clicking on the entries in the colour map list and changing the values.

o. Click the **Save As…** icon and name the colour map as **Rainbow_Modified**.

Colour maps are stored by default in the Colour directory.

Colour Range could be useful to identify depths on the same range and shoal areas (used to target areas to be dredge inside of a channel, for instance).



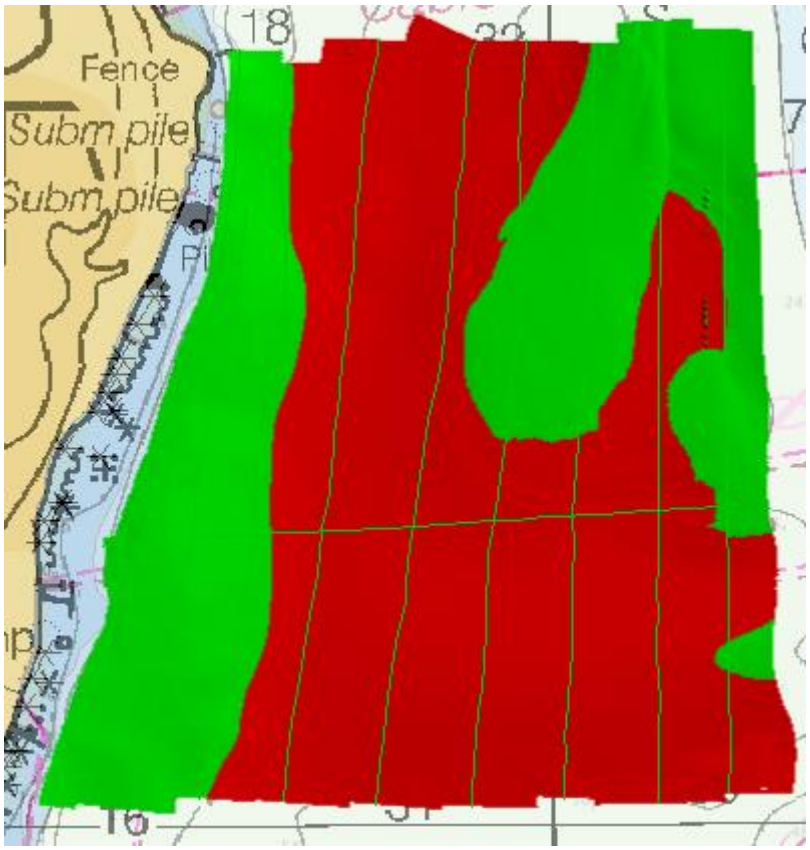
p. Select **New Colour Range…** option from **Colour File** drop list.

q. On the pop up window click on **Add** to add a new range.

r. Define the range as **Minimum** of **0.0 m** and **Maximum** of **40.0 m.** Define **Green** Colour as the **Start** and **End** Colours**. Click OK.**

s. **Add** a new range and define as **Minimum** of **40.001 m** and **Maximum** of **65 m.** Define **Red** Colour as the **Start** and **End** Colours**. Click OK**

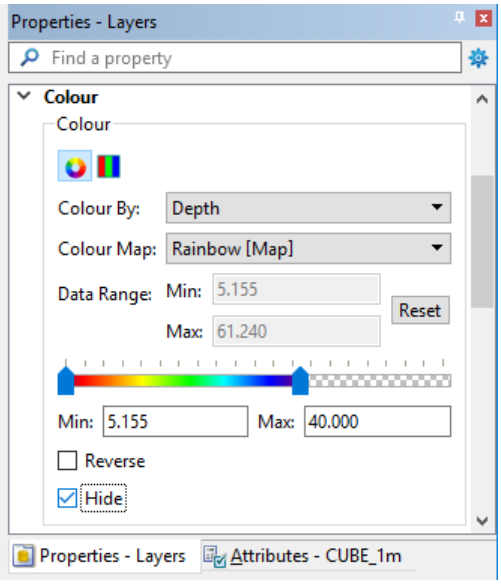
t. Click on **Save As…** button as save it as **CUBE_Range**



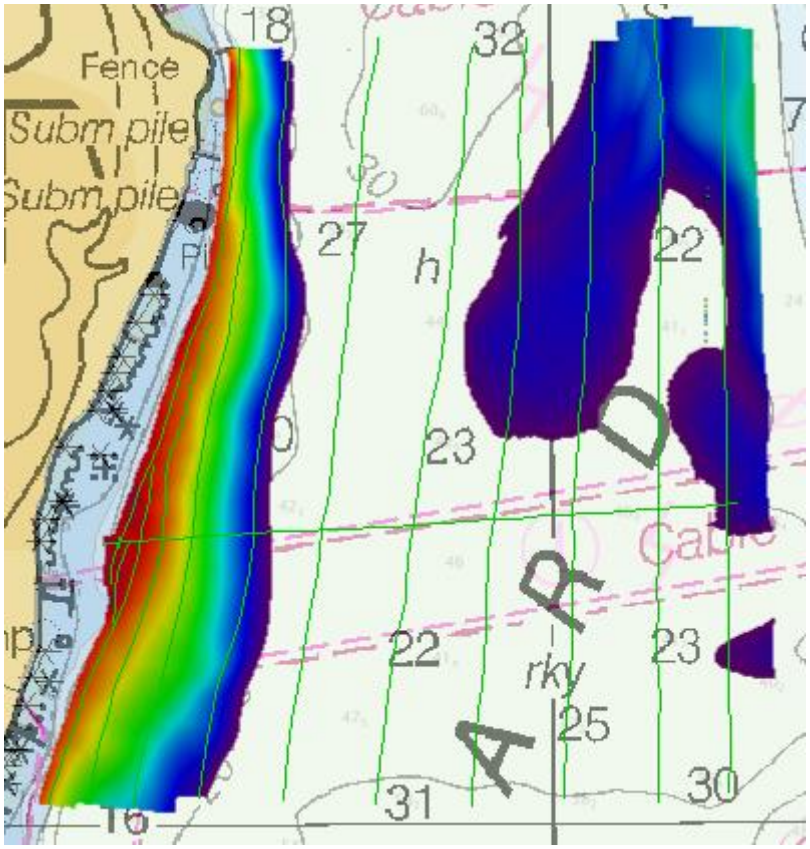
u. Return to the **Rainbow [Map]** colour.

Data Range: Shows the Minimum and Maximum values of the selected band in the surface.

Slider / Min Max values: Since the release of HIPS 11.0, you have now other way to interactive filter data, using the slider will reduce the data you'll see on the rainbow spectrum, moving the sliders, or typing an exact value. All the values outside of the range will be coloured purple by default, but checking the option Hide, those those values outside will be transparent.



v. Type on the **Max** field a value of **40** m. Enable the option **Hide**.



w. Move the right slider to the full right position. Disable the option **Hide**.

Reverse: Assigns the map Colour values (1-255) as Maximum to Minimum value, instead of Minimum to Maximum (Default).

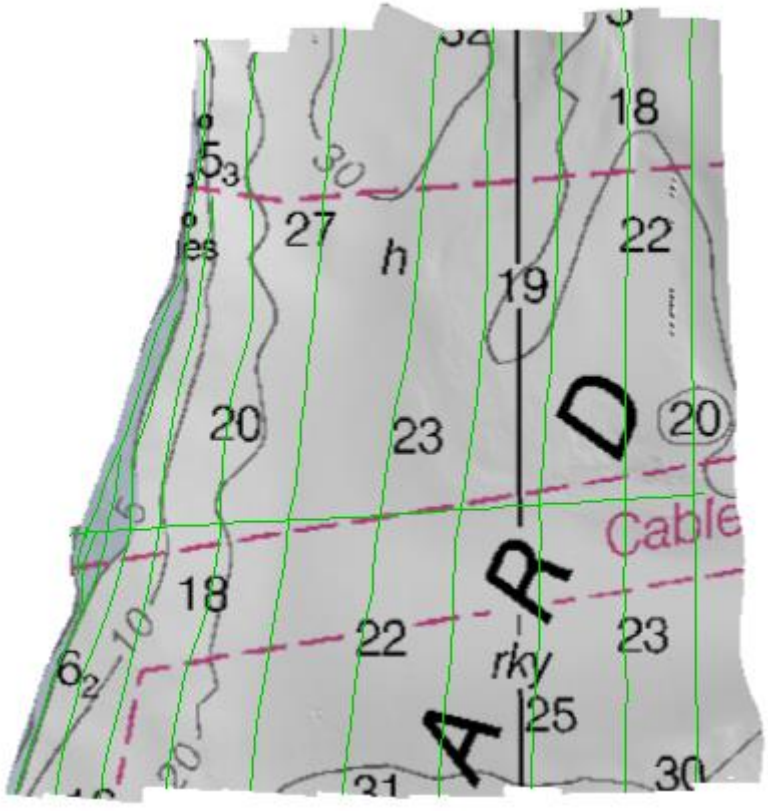
Hide – Makes the values transparent outside the Min and Max values.

Transparency: Set a transparency percentage to be applied to the display of the image. This is useful when displaying multiple images.

x. Type **50** for a transparency and press **Enter**. The survey lines can be viewed through the semi-transparent surface.

y. Change the transparency back to **0** and press **Enter** to update display window.

Drape: It's possible to drape raster images on top of surfaces on the Main Display (2D).



z. Turn off both Background Charts, **18474_1** and **US5WA14M** in **Layers** window to see better the effect of 2D drape on the main display.

aa. Highlight the **CUBE_1m** layer on the **Layers** window.

bb. Select **18474_1:Band 1** from **Drape** drop list.

cc. Select **(None)** from **Drape** drop list and Turn on Charts, **18474_1** and **US5WA14M** in **Layers** window.

Surface

Display Surface: Shows and hides the surface.

Use the **Vertical Exaggeration** option to control the apparent vertical height of the surface, as this can also help to distinguish features.

Light Position: Controls the shading on the image to bring out surface texture. The Light position can be changed, modifying the values for Light Azimuth and Light Elevation.

dd. Change the values of **Vertical Exaggeration** to **2**, **Elev** to **30** (Deg).

ee. Change the values back to **Vertical Exaggeration 1, Elev** to **45** (Deg).

Points

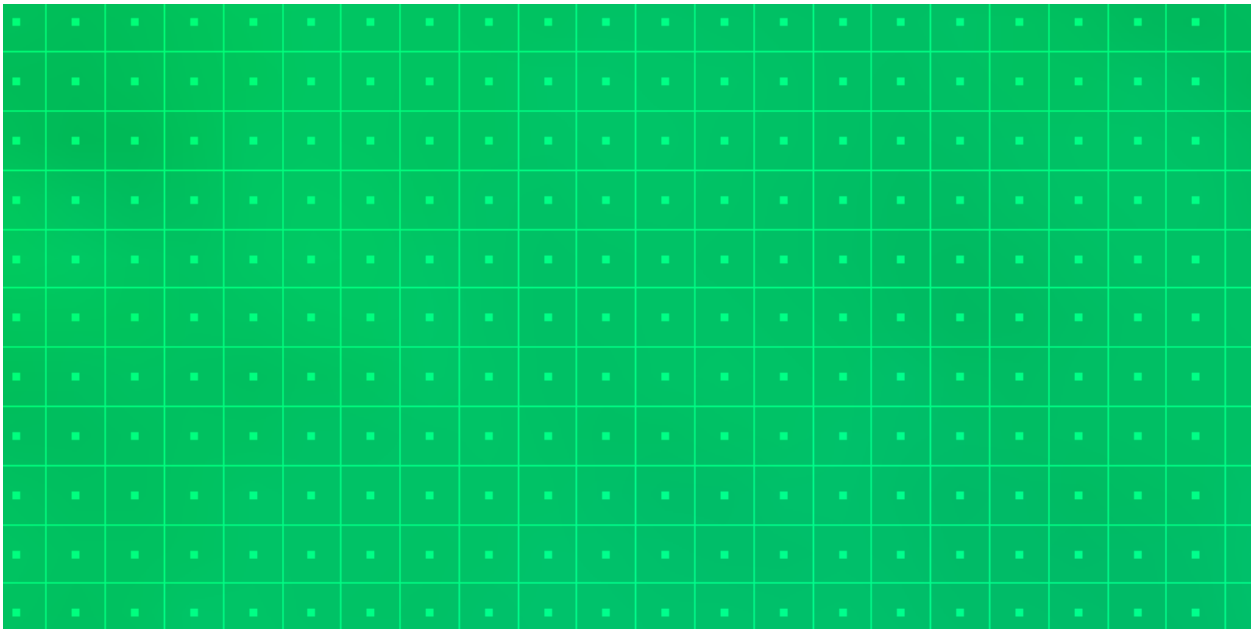
Shows the location of node points. By default disabled, hiding these node location points.

ff. Go to menu **View > Display Window Properties** and type **100** as the new scale value, click **OK**.

gg. Enable the **Display Points** under **Points**.

Cell Boundaries

Shows the size of Cell Boundaries in the surface (resolution). By default, value is (None) hiding these Cell Boundaries Size.



hh. Enable the **Display Cell Boundaries** option, under **Cell Boundaries**.

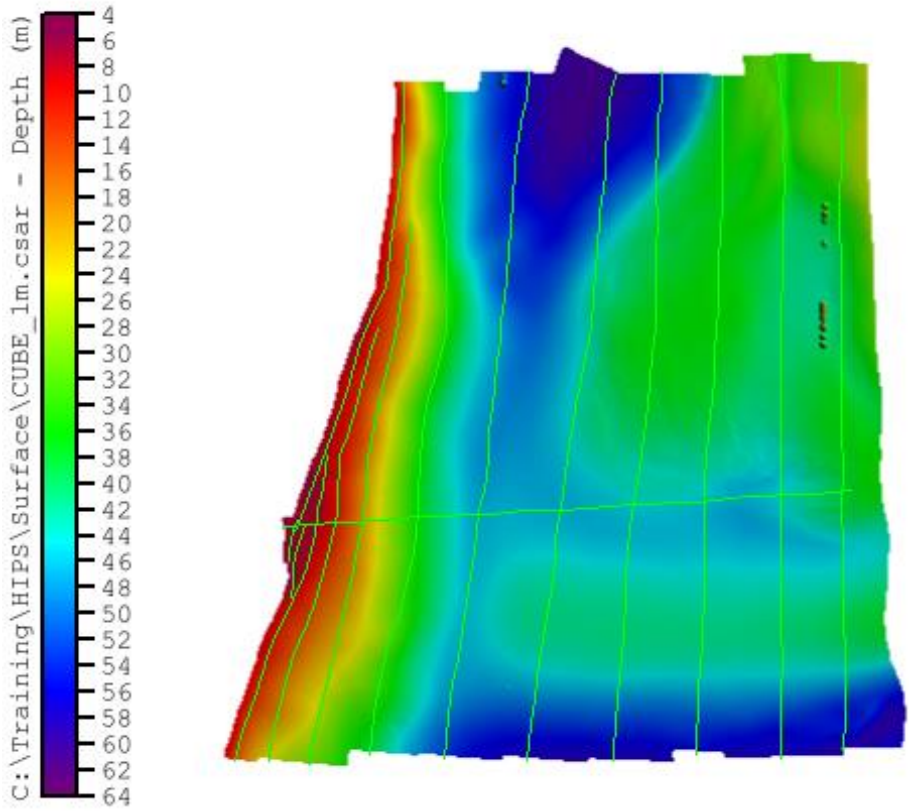
ii. Disable the **Display Cell Boundaries** and **Display Points** options. Right-click the **CUBE_1m** Main layer and click **Zoom to Source** from the drop list.

Digits

Alternatively you can display all sounding values, in small areas with big zoom scales. For big areas, it will follow the criteria to supress soundings described in that section.

Legend

Draw Legend: Enables the display of a Legend to show the correlation between the surface values and selected colours in the HIPS Display window.



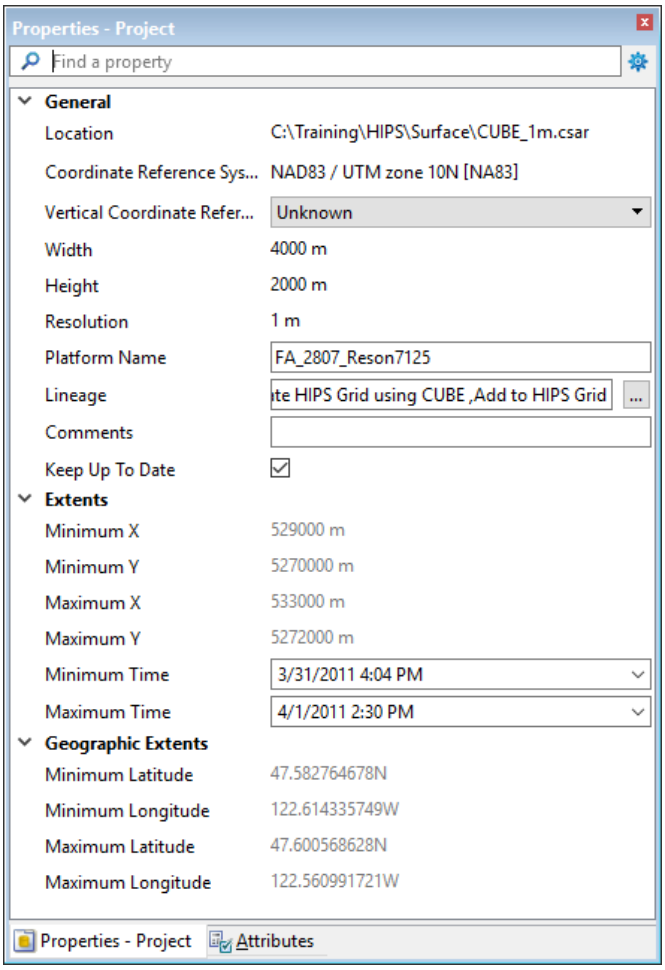
jj. Under **Legend**, enable the **Draw Legend** option, this must be enabled to include a legend with a surface layer during View export.

kk. Under **Legend**, disable the **Draw Legend** option.

ll. Save the project by selecting File > Save > Save Project…

Layers and Bands Metadata

General layer information, including Location, Coordinate Reference System, Metadata (Width, Height, Resolution, Extents and Timestamps) as also Lineage (Sources and Options used), can be viewed in HIPS via the Properties - Project window.

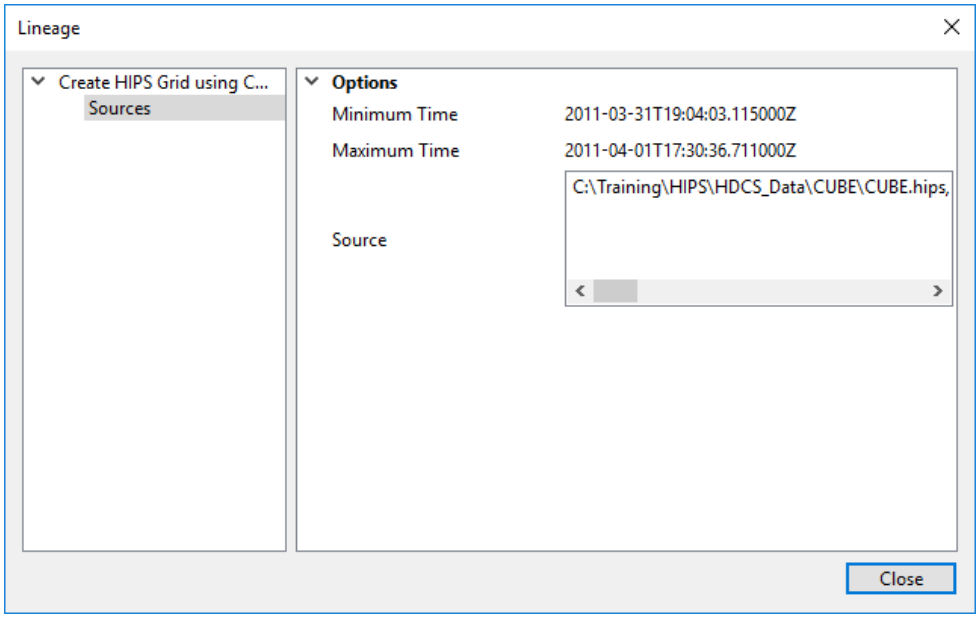


The display coordinate reference system for the project can be changed in Properties window.

Exercise 39.

a. Select the **CUBE_1m** Surface layer within the **Project** window.

b. In the **Properties** window, click **(…)** Browse in the **Lineage** field.

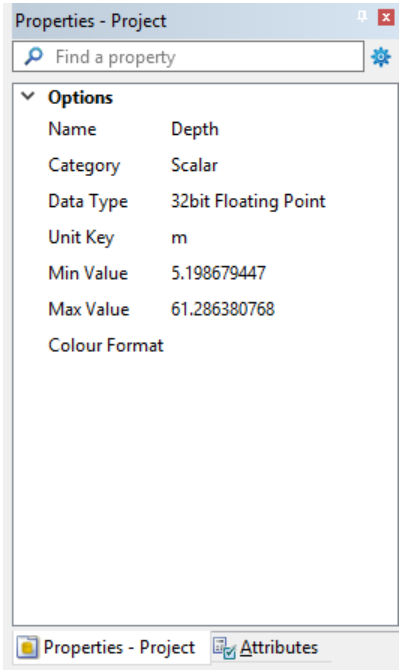


c. On the emerging window select the **Create HIPS Grid using CUBE layer**. You'll see all the options used to create the Surface.

d. Select the **Sources** layer under Create…. You'll see the lines used to created the surface.

e. Click **Close** to close the dialog box.

Also Bands can be consulted using the same Properties window.



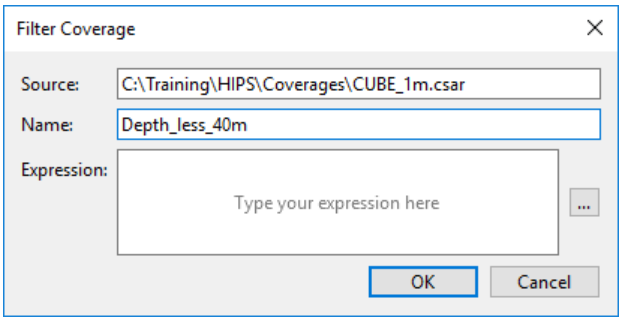
f. In the **Project** window, unfold the **CUBE_1m** object and under bands highlight the **Depth** Band.

Filter Coverages

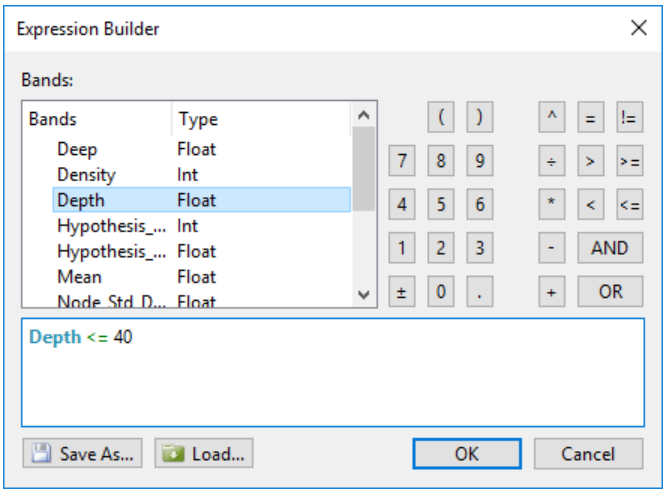
Same as you could filtering visually the surface, you can do that filtering permanent creating a new layer (diferent *CSAR file) which will be on memory until you saved it.

Exercise 40.

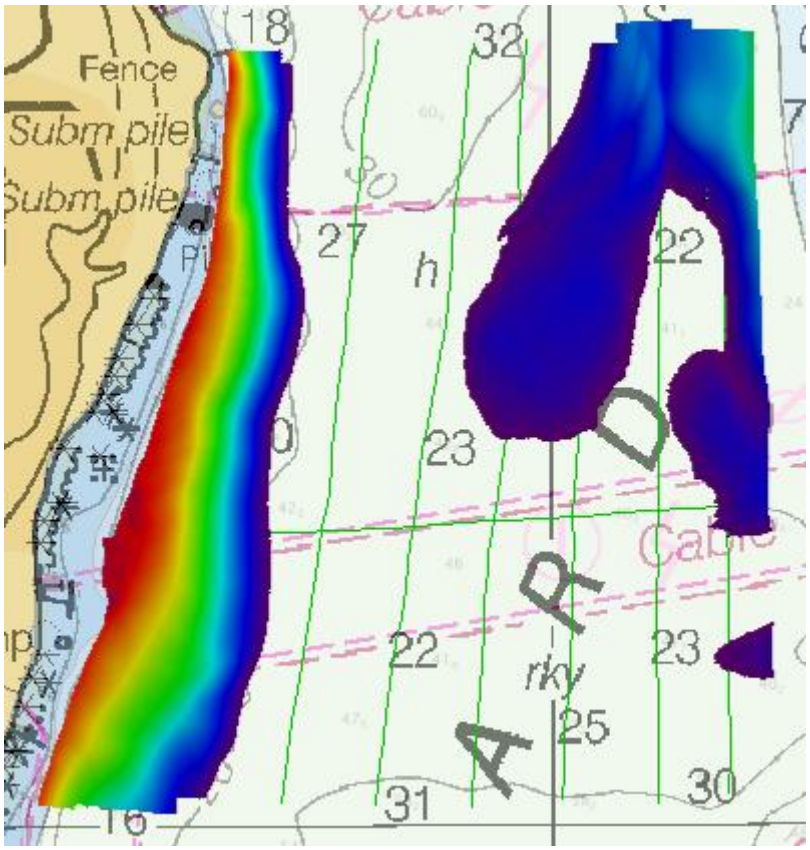
a. Right click on the layer **CUBE_1m** on the **Layers** window and select the option **Tools > Filter...**



b. On the **Filter Coverage** window, type **Depth_less_40m** as the **Name** of the layer and click on the browse option on **Expression**.



c. Double click on the **Depth** band, this will add **Depth** to the expression. Click on less than or equal to (**<=**) symbol. Then type **40**. Click **OK**.



The new Layer Depth_less_40m, will be on memory until you save it. The icons Save and Save all are now active. You will just close this new created layer.

d. On **Project** window right click on the **Depth_less_40m** layer and select **Close Source** from the pop up menu. Don't save the changes.

Variable Resolution Surface

With the release of HIPS 10.0, new functionality has been added to allow the creation of Variable Resolution Surfaces.

Variable resolution surfaces are surfaces in which the resolution can vary in different regions, while maintaining continuity across the entire surface. The desired resolution in discrete areas is determined using selected algorithms, instead of setting a fixed resolution based on subjective choice.

The first step to create a variable resolution surface is to determine how to subdivide the mapped region, and what the resolution should be assigned to each sub-region (or tile). One option is to select a parameter to define the required resolution in each tile. An alternative is to analyze the source data on several criteria to determine the optimum resolution for each. The process starts by dividing data into regular tiles, in this case using a quad-tree-structure, recursively dividing binary space partitions until each tile contains the appropriate number of data samples. Once the data area is subdivided a resolution for each tile must be determined using a resolution estimation method. The available methods are:

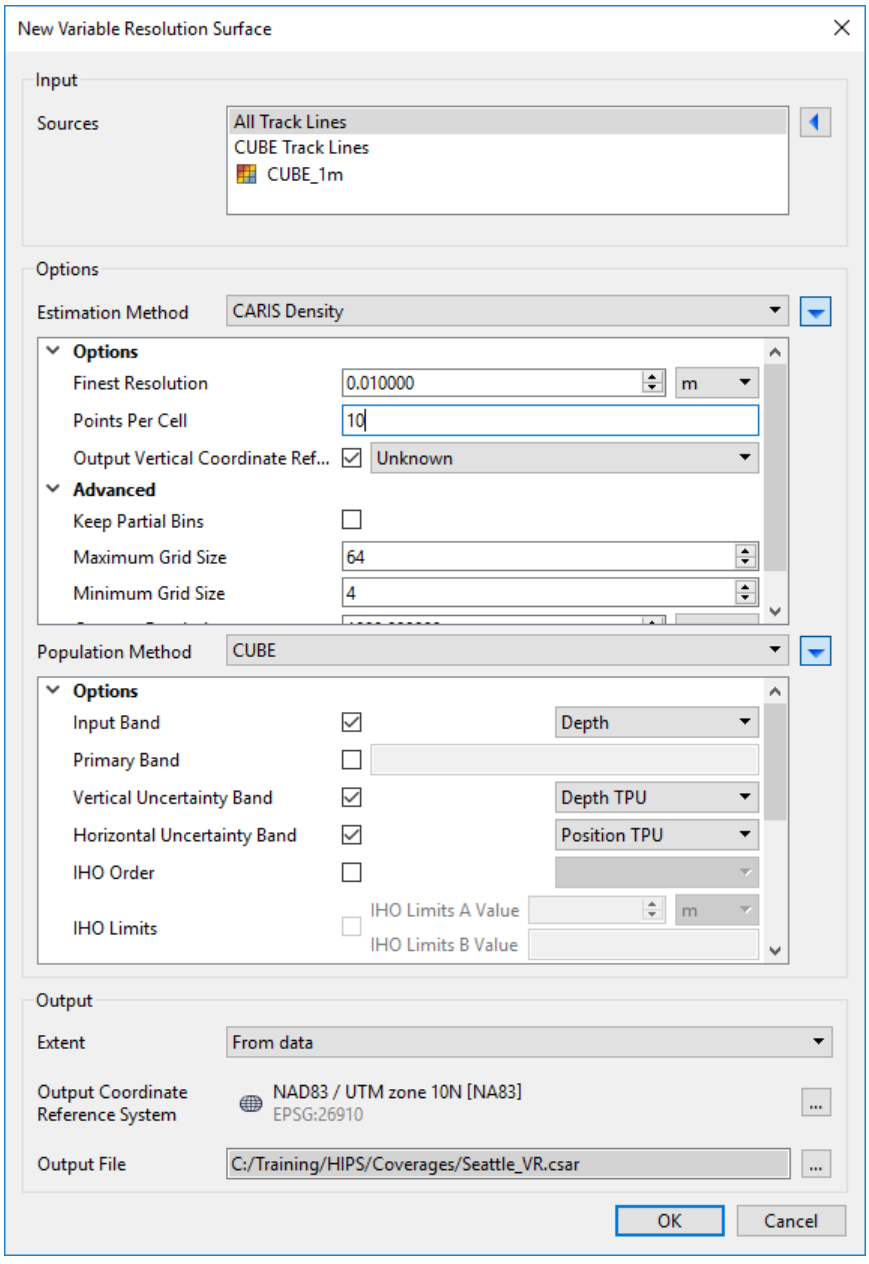
- **Density (CARIS):** Estimates the resolution based on source point density
- **Density (Calder-Rice):** Estimates the resolution based on point density over an area
- **Ranges:** Assigns a resolution based on a tile statistic (such as min., max., mean) and a look-up table of resolution vs. value.

The resulting quad-tree and computed resolution for each region are stored as the Resolution Map for the dataset. From this point, the source data is gridded in each tile using traditional techniques such as:

- **Inverse distance weighting:** Depth is determined by calculating the mean of all samples in the specified neighbourhood, weighted by a function of the inverse of the Euclidean distance from the sample to the node.
- **CUBE:** Several hypotheses will be calculated based on depth and uncertainty, and the strongest hypothesis returned
- **Uncertainty:** Depth is determined by calculating the mean of all samples in the resolution bin, weighted by a function of distance and sample uncertainty.
- **Mean:** The average value of all points within the tile.
- **Swath Angle:** Value set using beam angle and footprint radius that defines the maximum area to which points will be applied
- **Selected value:** A single value for the node is used to populate each cell based on the selection criteria set in the options. The **Shoal Bin Selection**, together with **Original Position** for **Node Position**, would be the same technique described in **Shoalest Depth True Position** for Regular Gridded surfaces. There are Deep and Bin Center options too.

Exercise 41.

a. Click the **New Variable Resolution Surface** icon, or **Tools > Coverages > Grid > Variable Resolution Surface…** option from the main menu.



b. In the **New Variable Resolution Surface** dialog box, check the **Input > Source** is **All Track Lines** and click on the arrow icon on the right to unfold the options.

c. In **Options**, leave the **Estimation Method** as **CARIS Density**, and click on the arrow icon on the right to unfold the options.

d. Ensure the following options have been selected:
   - **Finest Resolution: 0.01**
   - **Points Per Cell: 10**
   - **Maximum Grid Size: 64**
   - **Minimum Grid Size: 4**
   - **Coarsest Resolution: 1000.00**

e. In **Population Method** select **CUBE** and click on the arrow icon on the right to unfold the options.
   Ensure the following options have been selected:
   - **Input Band: Depth**
   - **Vertical Uncertainty Band: Depth TPU**
   - **Horizontal Uncertainty Band: Position TPU**
   - **Disambiguation Method: Density and Locale**
   - Enable **IHO Order** and select **S44 Special Order**
   - Enable **Comments** and type **Variable Resolution Surface.**
   - Enable **Keep Up to Date**
   - **Display Bias: Random**

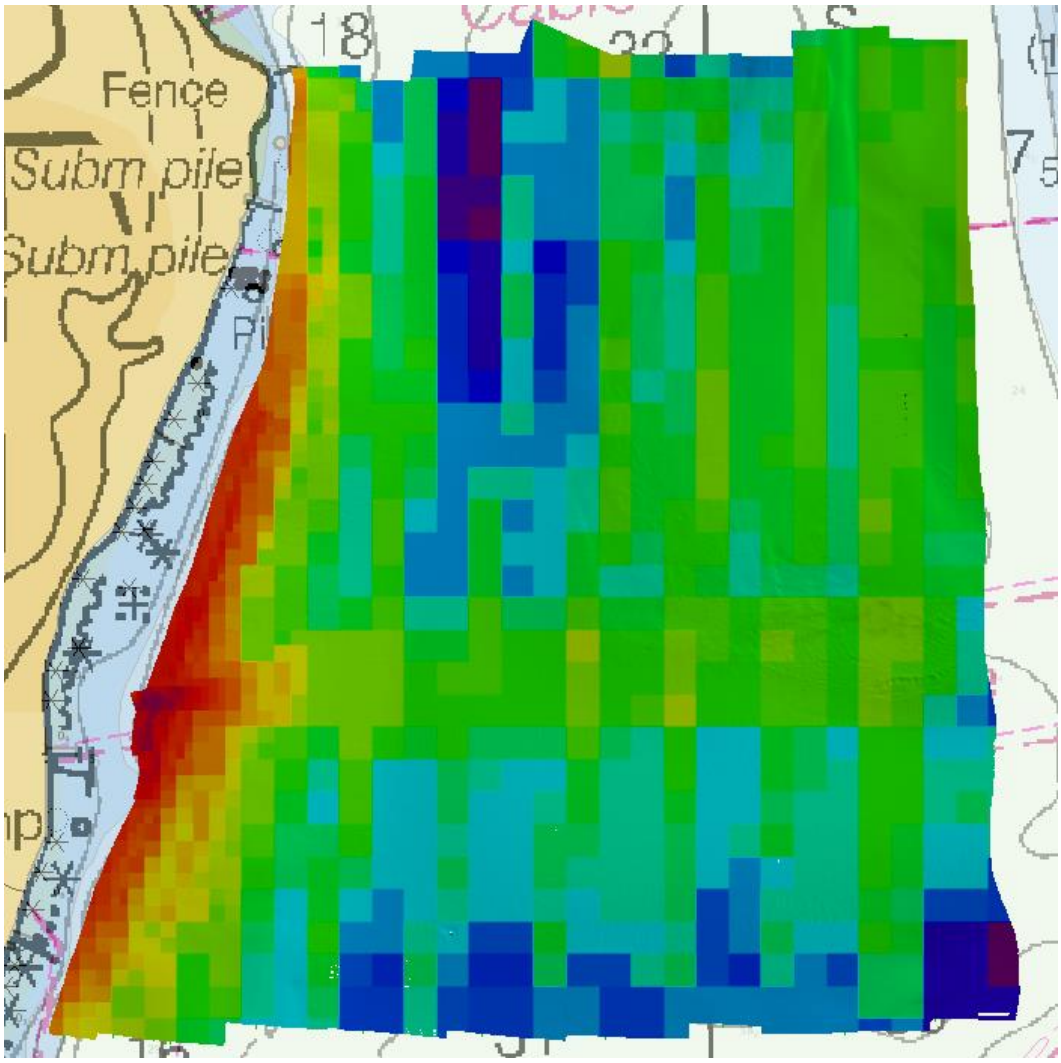
f. On **Output > Extent** select **From data**, where the software will find out what are the minimum and maximum extents values.

g. On **Output Coordinate Reference System** use the default (same as the project: **NAD83 / UTM Zone 10N [NA83] EPSG:26910**)

h. On **Output File,** click the browse **…** option to give a name and location for the resulting surface. Save it as **Seattle_VR** in the **…\Coverages** folder.

i. Click **OK**

To see better what the software did, determining different resolutions on different areas of the survey, it would be useful to view the Resolution Layer of the variable resolution surface,



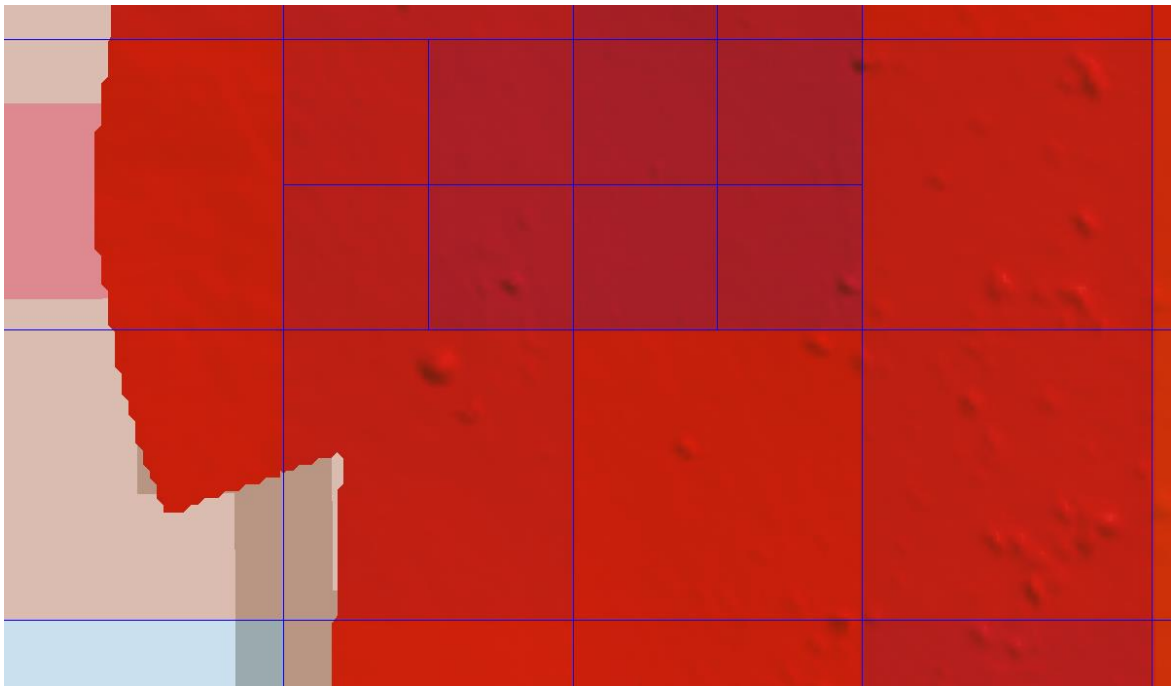
j. Highlight the layer **Seattle_VR** on **Layers** window and on the **Properties** window, under **Colour**, set **Colour by** to **Resolution**.

A quick view of this layer, will show the areas with the Best Resolution (lowest number) are the ones in shallow depths and the ones with overlapping areas, because they had dense data enough to create smaller cells.

The resulting quad-tree and computed resolution for each region are stored as the Resolution Map for the dataset.

g. In the **Project** window, unfold the **Seattle_VR**; right click on **Resolution Map** band and select **Add Layer**.

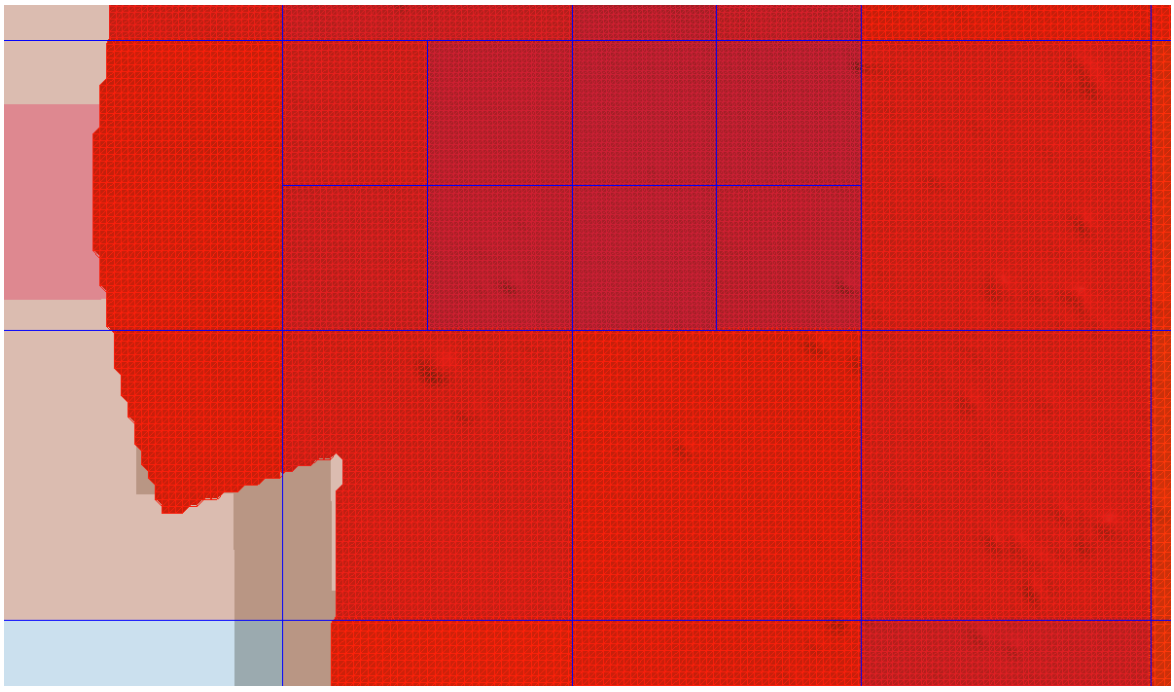
This layer is already semitransparent showing just four squares of the main surface. When zooming in it shows more detailed squares of each resolution sub area tile.



k. Zoom in until you start to see the subdivisions for each resolution area.

l. Turn off the checkbox of **Seattle_VR - Resolution Map** layer

Similar to the cell boundaries on regular gridded surfaces, the wireframe visualization in variable resolution surfaces will help to understand the different resolution nodes and their connection.



m. Highlight the **Seattle_VR** layer and on Properties window, enable the **Display Mesh** option under **Wireframe**

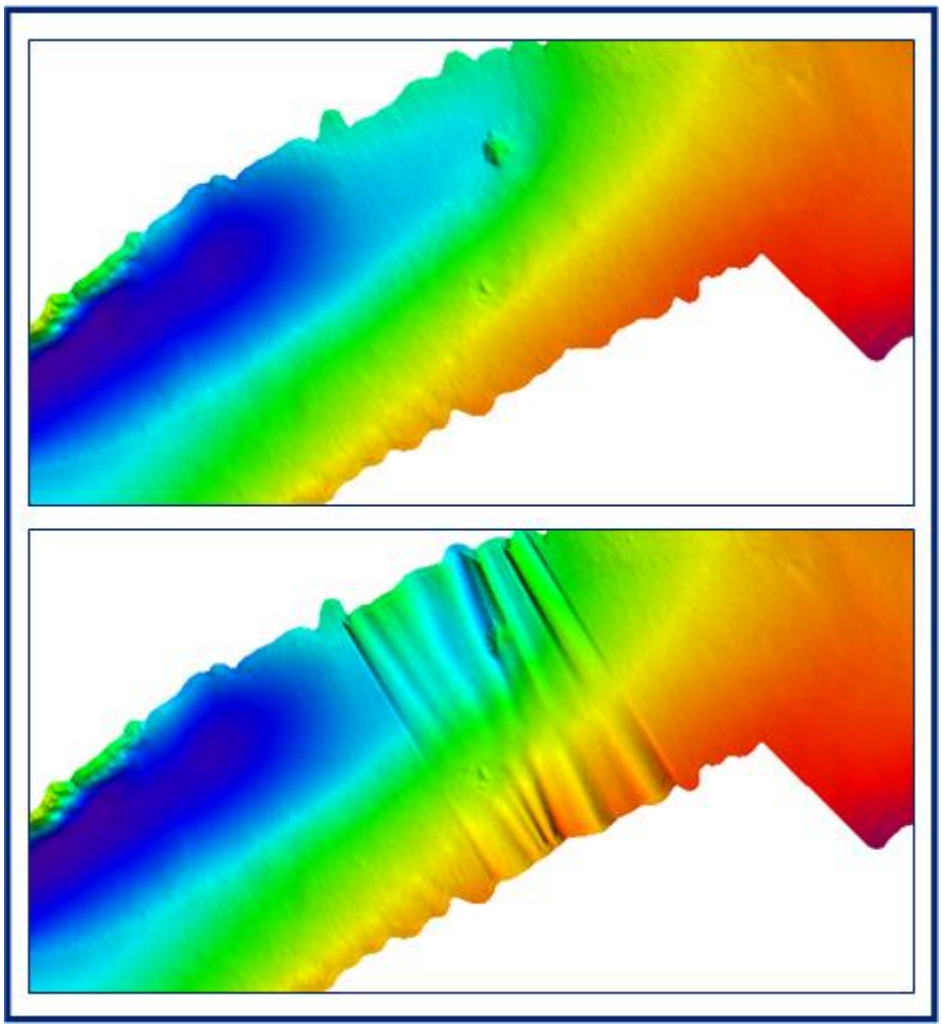
n. Once you've reviewed the different resolutions, disable the **Display Mesh** option under **Wireframe**

o. Highlight the layer **Seattle_VR** on **Layers** window and on the **Properties** window, under **Colour**, set **Colour by** to **Depth.**

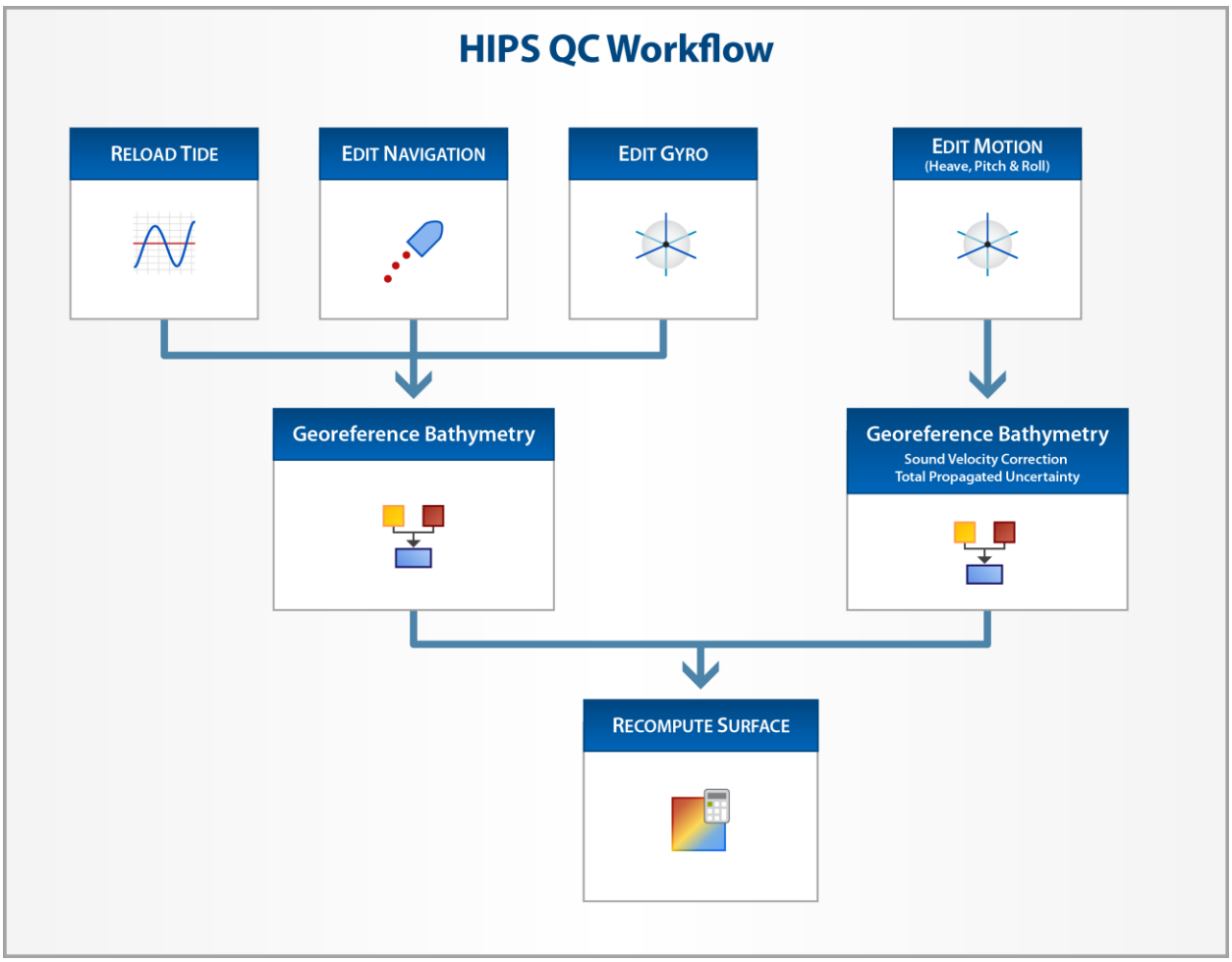
p. Save the project by selecting **File > Save > Save Project…**

Data Quality Control

You have thus far created a CUBE surface, but have not analyzed the auxiliary sensor data. The surface can be used to highlight problems that may exist in the attitude and/or navigation data, or sounding outliers that can be removed by hydrographers. Processing efficiency can be improved by using the existing gridded data to highlight problems in the auxiliary sensors as users are no longer required to investigate the motion and navigation of each survey line. The illustration below shows how a problem with sensor offsets, auxiliary sensor data, etc. can become apparent in the surface.



It is necessary to repeat certain steps that have already been applied to the data if any changes are made to the navigation and/or motion. The workflow diagram below outlines these operations.



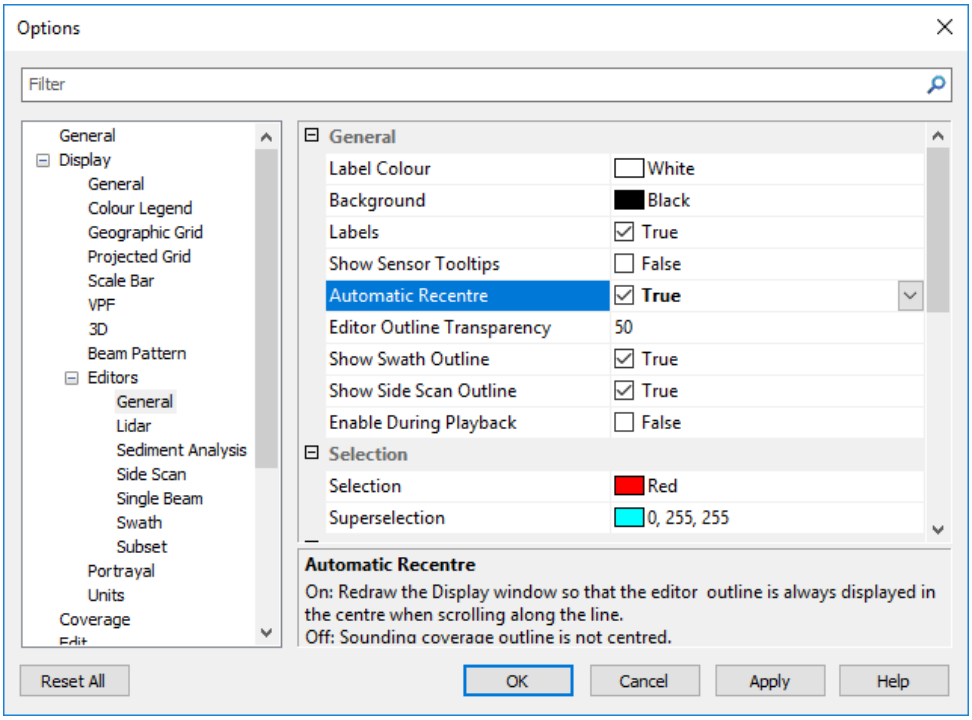
Line Editors

HIPS enables you to edit information on a line by line basis. For multibeam data, **Navigation** (position) data, **Attitude** (motion) data, and **Swath** (bathymetry) data can be edited.

Note: Only one line can be edited at a time when using Navigation and Swath editors. The following sections discuss each of these Editors.

Navigation Editor

Navigation Editor lets you examine and clean individual position fixes for each navigation source as recorded by the vessel's positioning system. Since release of HIPS 9.0, you have the ability to select which Navigation Source will be choose as the main Navigation source for each Ship Track Line.

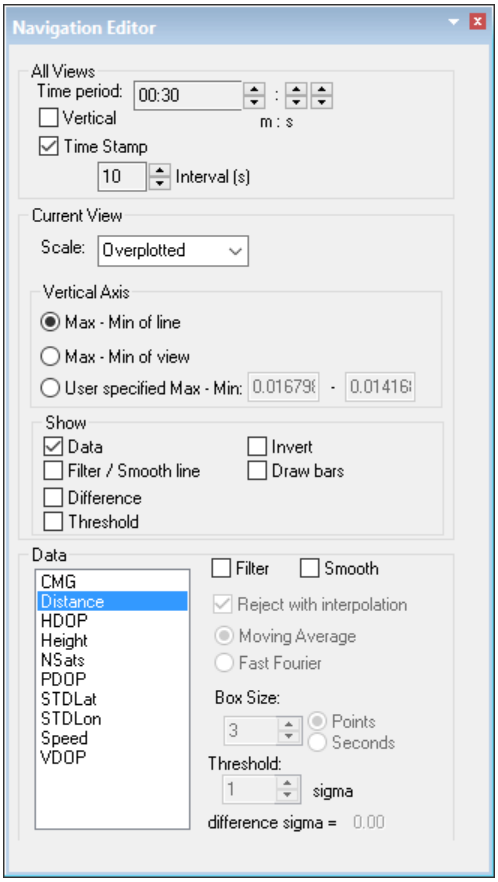


Exercise 42.

a. Go to **Tools > Options** and under **Display > Editors > General**, turn on the two checkboxes **Show Sensor Tooltips** and **Automatic Recentre** to **True**, and click **OK**.

b. Select the line **2011M_0901903** in either the **Active Track Lines** or **Display** window.

c. Click the **Navigation Editor** icon or the **Tools > Editors > Navigation > Navigation Editor** menu command.



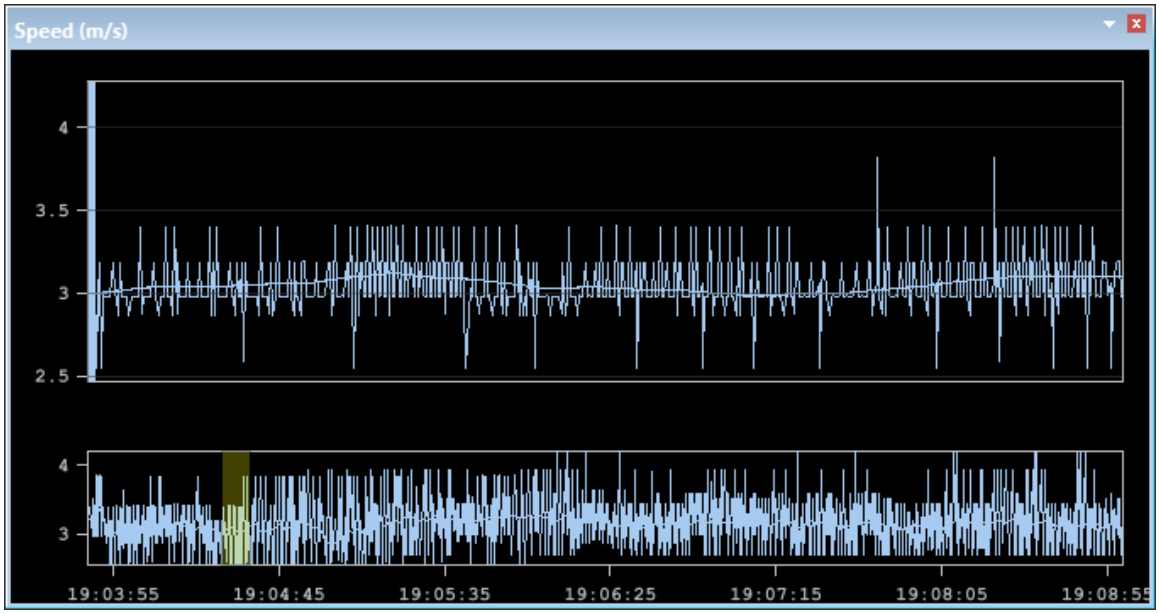
The **Navigation Editor** will be added. Track lines are displayed within the display window as a series of continuous symbols, with each point representing a navigation fix.

CMG, Distance, HDOP, Height, NSats, PDOP, STDLat, STDLon, Speed and **VDOP** are all listed in the **Data** section of the Navigation Editor. If you are interested in removing or adding one of the graphs from the view the menu can be used.

d. Go to **Tools > Editors > Navigation** and click **CMG**.

Note: In the dropdown menu in **Tools > Editors > Navigation** a checkmark beside the data source, indicates the graph is visible. Selecting the same source a second time will remove the graph from the display and remove the checkmark.

Navigation Editor displays graphs for distance and speed data. The image below shows the distance data. The overview graph is displayed at the bottom of the window, showing all data for the selected line. The yellow slice allows you to manually edit how much of the data should be visible in the upper graph.

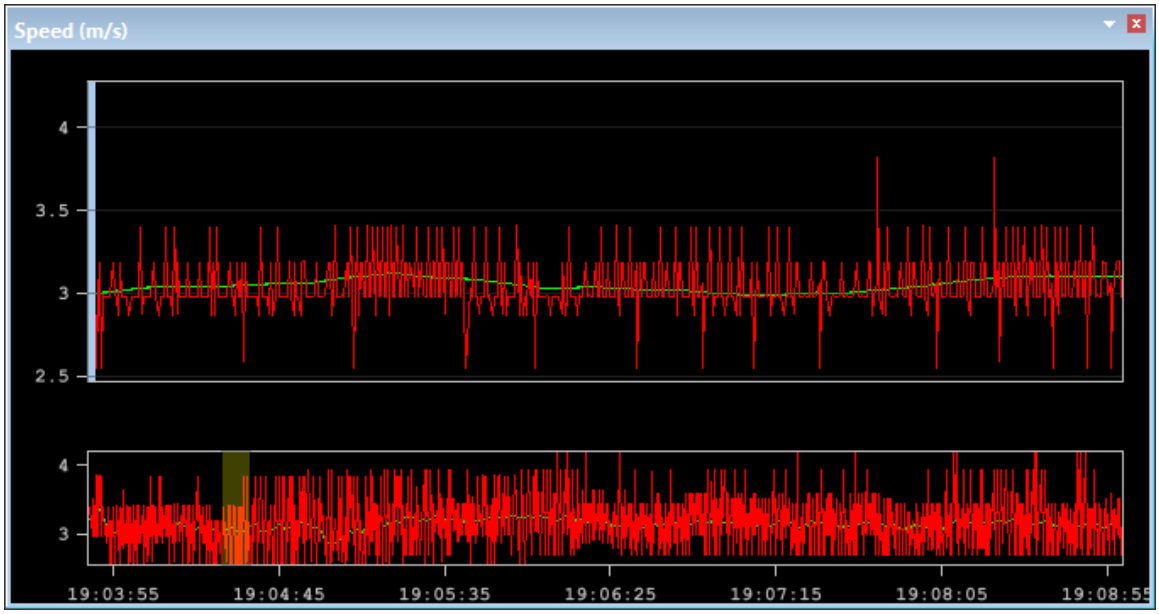


e. With your mouse in the middle of the yellow slice, you can click, hold and move the yellow slice along the selected line data.

f. Moving your mouse to the left or right edge of the yellow slice a double arrow will display. Click, hold and move your mouse to increase the amount of data visible in the upper graph.

g. To make more room on your screen, right-click within the distance graph and click **Hide Overview** to remove the overview from the graph. You can right-click again and click **Show Overview** to redisplay the overview.

In Navigation Editor, it is possible to choose between more than one navigation source for processing purposes. The navigation graphs can be used to help identify the behavior of each navigation source.



Exercise 43.

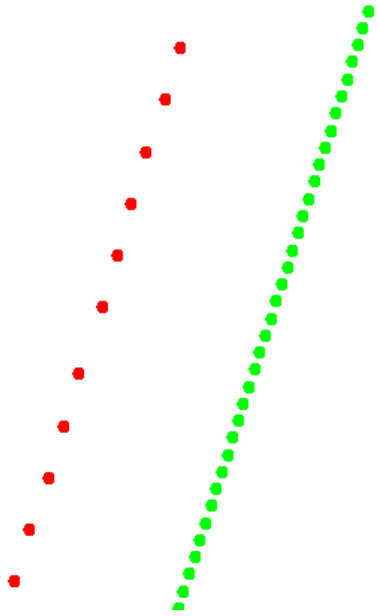
a. Go to the **Layers** window and expand the tree on **All Track Lines.** There you'll see the name of the line **2011M_0901903** and its two Navigation Sources **HDCS.Nav** and **Applanix.SBET.**

b. Highlight the **HDCS.Nav** and in the **Properties** window, assign a different colour to it.

c. Repeat the procedure for **Applanix.SBET** layer assigning to it a different color than the **HDCS.Nav**.

d. Check the differences between the two navigation systems in **Distance** or **Speed** windows.

The data can also be viewed on the main Display, showing the differences between the two sources (position and frequency).



e. Leave only the **Applanix.SBET** layer enabled to make all the further editions on this source (as the main one).

The **Navigation Editor** has the following options:

The **All Views** section has three controls that act on all of the time-series graphs together. The time period option determines the amount of data to be shown in graph; the longer the period of time, the more data displays. The Vertical option switches the graphs to run vertically and you can also select it to enable Time Stamps to be displayed on the graphs and specify the interval.

The **Current View** options enables you to specify if the vertical scale will be controlled by the extents of the currently displayed data, the extents of the entire line or user-defined minimum and maximum values is used to choose whether to scale the Y-axis of the graphs based on the values on one screen or the whole line. The Scale options are applied to the data item currently highlighted.

Note: The **Scale** options **Fixed** and **Overplotted** are applicable only to **Attitude Data**, that will be covered on the **Attitude Editor** section.

Select the line type to be displayed in the graphs in the **Show** section. The data display can be enabled/disabled, by going to **Tools > Editor > Navigation** and selecting the source of interest to display or remove from the view. It can also be inverted (for display only), and bars can be drawn to distinguishing each data point.

The **Filter** checkbox is used to turn on filtering for the selected data types. There are two methods of filtering **Moving Average** and **Fast Fourier**. This option is also available in the Filters tab which will be discussed later.

The **Moving Average** option works by averaging data within a window. The window size can be based on seconds or number of data points. Increasing the size of the window increases the level of smoothing.

The **Fast Fourier** option takes out all frequencies which have a shorter wavelength than the box size set in points or seconds.

The **Threshold** option sets the cut-off value as a multiple of the standard deviation. The cut-off value is applied to the difference data.

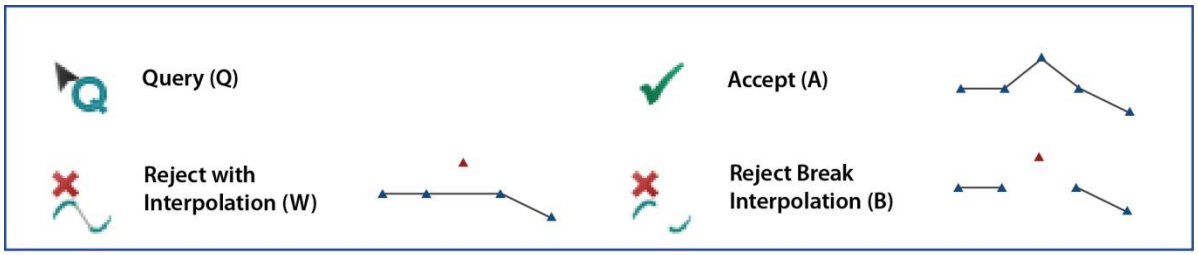
The **Difference** between the filter line and the sensor data is then calculated. This difference will be greater in areas in which local variability is high. Any difference values outside of the threshold limit will be rejected with interpolation.

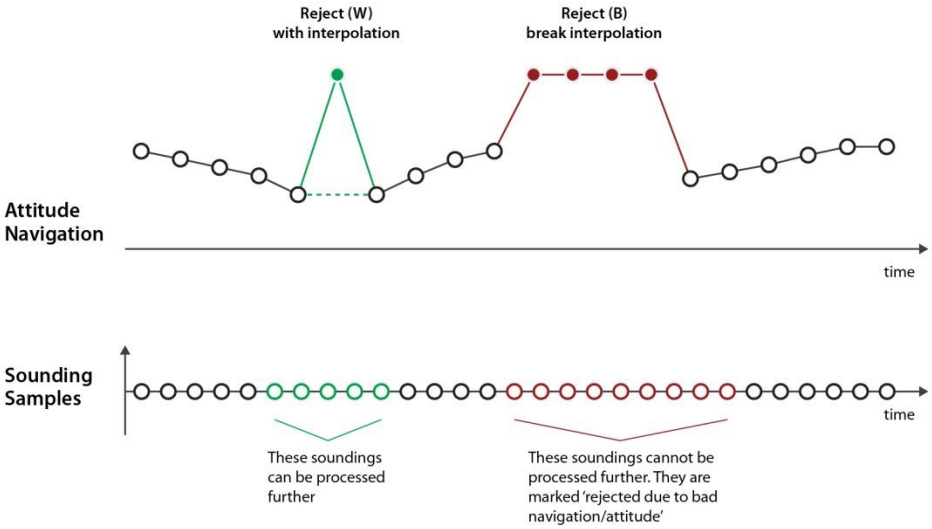
Each navigation source can be examined with the use of two graphs within a single window extent. An option overview graph at the bottom shows all the line data with a little yellow reference box that you can resize to change the details within the main graph at the top of the window. As you move your mouse within the main graph, a Tooltip box will display information for all sources enabled within the layers window.

Filtering can be applied in three ways:
- Filter screen (only the information displayed by the yellow slice within the graph),
- Filter End of Line (from the yellow slice to the end of the line), or
- Apply interpolate Navigation points outside of Navigation Editor.

Filtering can be applied with or without interpolation.

There are four main edit functions that are used when editing data in Navigation Editor or Attitude Editor:
- Query,
- Reject with Interpolation,
- Reject Break Interpolation, and
- Accept.





- **Query** – Query gives the details of the navigation points in the Selection window. The data can then be sorted in ascending or descending order by clicking the column heading. This can be useful for finding jumps and spikes. The selected data is automatically queried and showed on the **Selection** window, also the **Q** key can be used. The whole line can be queried by right-clicking and selecting **Query Line** from the pop-up menu. This information is stored in memory, and thus retrieving of it is quick. The data shown in the query table can be copied and pasted or simply saved to a text file for further use.

- **Reject - Break Interpolation** - This will reject selected soundings without trying to interpolate their position. (Navigation for the pings is interpolated from the navigation data.) This function causes all soundings between the navigation fixes immediately before and after the gap to be rejected. Use **B** as a shortcut key.

- **Reject - With Interpolation** - This rejects selected navigation fixes but interpolates a position over the gap. This can also be activated using the **W** key.

- **Accept** – Accept will change the status of all selected sounding positions to Accepted. This can also be activated using the **A** key as a shortcut.

You will practice these edit functionalities in the following exercise.

f. Within the **Distance** window make a selection of several points.

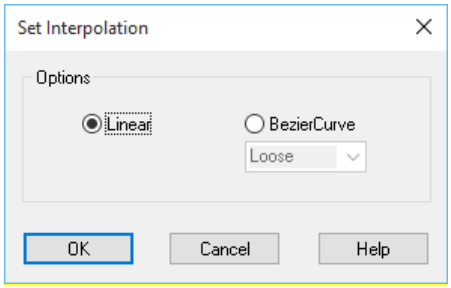
g. See on the **Selection** Window the queried data results.

h. Click the **Navigation Editor** icon to close Navigation Editor.

Navigation Interpolation

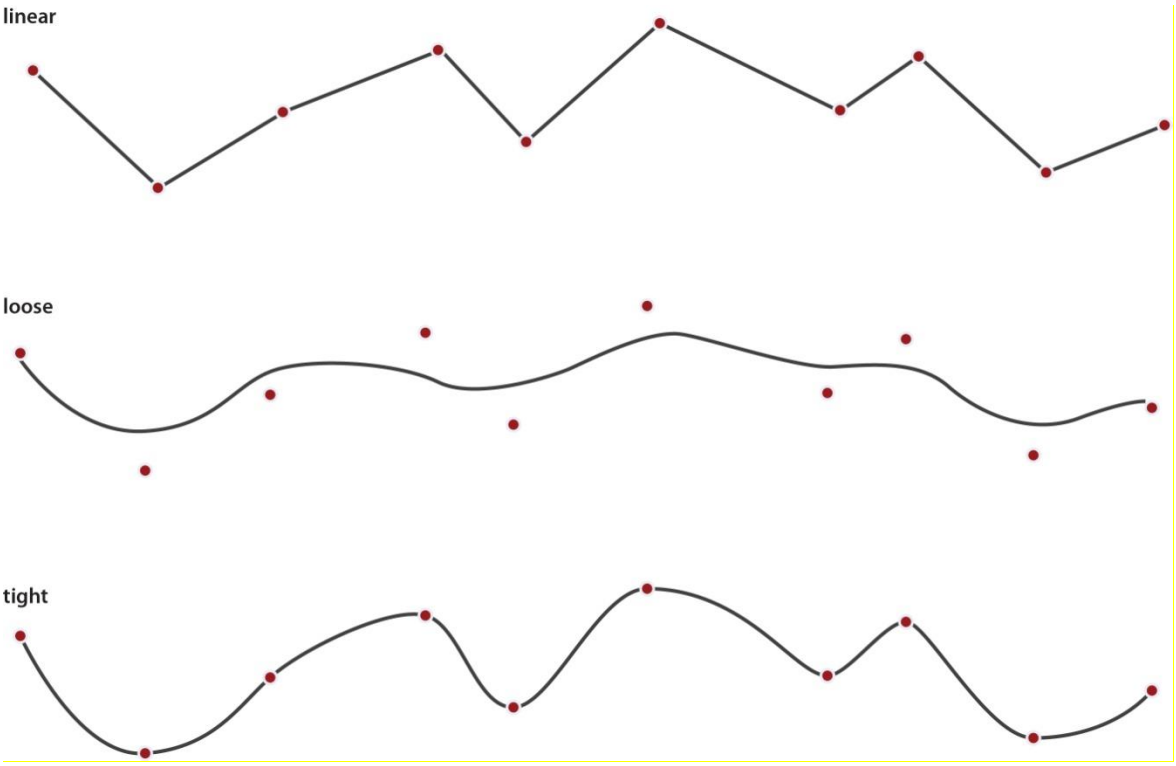
You can interpolate the Navigation points using the **Tools > HIPS and SIPS > Navigation > Set Interpolation…** menu. It opens a dialog box where you can select the options for one line or all lines on the project at the same time, dependent on which ones were selected before open the dialog box.

Position observations do not usually occur at exactly the same instant in time as a depth observation (ping). It is also unlikely that there is an exact position for every ping. For example, positions may be observed every second (1 Hz), while depth pings may be observed 10 times a second (10 Hz) or more. In most cases it will be necessary to interpolate positions to match the times for each ping.



The default method is **Linear**, where interpolation between each successive position is obtained by simply connecting the positions with a straight line. Linear interpolation is suitable when original navigation positions are clean and do not significantly deviate from the neighbouring positions.

The other three options (Loose, Medium, and Tight) are various degrees of **Bezier Curve**, (illustrated below). In these cases, the line of interpolation will not follow the navigation positions exactly.



Further editing of navigation fixes in Navigation Editor also enables you to control whether and how the remaining neighbouring fixes are interpolated.

Attitude Editor

Attitude Editor is used to display and edit motion sensor information. The primary sensors that can be displayed and edited include: Gyro, Pitch, Heave and Roll. If available, these sensors can also be displayed and edited: SSP (Surface Sound Speed), Tide (must be loaded), GPS Tide (must be calculated), GPS Height, Delta Draft (ROV depth), and Delayed Heave (must be loaded). As well uncertainty data (RMS) is available (if loaded) for these sensors: Heading RMS, Pitch RMS, Vertical RMS (GPS Height RMS), Roll RMS, Delayed Heave RMS. Side scan sonar sensors could include: SSS Gyro, Cable Out (or Layback), SSS Roll, and SSS Pitch.

Exercise 44.

a. Select the line **2011M_0901903** in either the **Active Track Lines** or **Display** window.

b. Click the **Attitude Editor** icon or go to **Tools > Editors > Attitude > Attitude Editor…** menu.

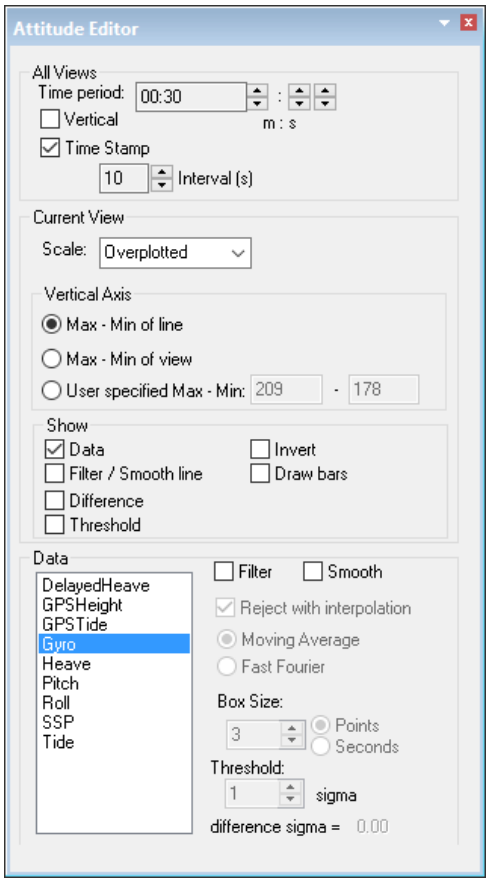
More sensors can be added by selecting them from the available sensors list, which can be accessed from the **Tools > Editors > Attitude…** menu.

The Gyro, Heave, Pitch and Roll sensor information is displayed by default.

- Gyro data in CARIS HIPS is displayed as a positive value when a clockwise rotation is experienced.
- Heave data in CARIS HIPS is displayed as a positive value when the vessel is heaved upwards.
- Pitch data in CARIS HIPS is displayed as positive when the vessels bow is down.
- Roll data in CARIS HIPS is displayed as positive when the vessels starboard side is up.

The four default windows in Attitude Editor display time series graphs for gyro, heave, pitch and roll. You can open the graphs from other available sensors using **Tools > Editors > Attitude** menu. Here you can select which graphs you would like to display or hide from the Display window.

The tools to manipulate this data are available in the **Attitude Editor** window. When the cursor is placed on one of the time series graphs, the value is displayed as a tool tip.



The **All Views** section has three controls that act on all of the time-series graphs together. The time period option determines the amount of data to be shown in graph; the longer the period of time, the more data is displayed. The Vertical option switches the graphs to run vertically and you can also select to enable Time Stamps to be displayed on the graphs and specify the interval.

The **Current View** options for **Scale** can be set to **Fixed** or **Overplotted**. On the Fixed option, the scale is defined by the Max-Min values from all sensor displayed and the Overplotted the scale is defined by the active data Type only.

The **Vertical Axis** options enable you to specify how the vertical scale will be controlled; by the extents of the currently displayed data, the extents of the entire line, or user-defined minimum and maximum values. The Scale options are applied only to the data item currently highlighted.

Select the line type to be displayed in the graphs in the **Show** section. The data display can be enabled/disabled, it can be inverted (for display only), and bars can be drawn to distinguish each data point.

The **Filter** checkbox is used to turn on filtering for the selected data types. There are two methods of filtering **Moving Average** and **Fast Fourier**. This option is also available in Attitude Filters, which will be discussed later.

The **Smooth** operation has the same parameters as the **Filter** operation. Only one smoothing operation can be completed on one sensor at a time. The magenta curve will be used instead of the original data. The new values are stored as a coefficients file, which you have to specify application of during Sound Velocity Correction in Georeference Bathymetry.

The **Moving Average** option works by averaging data within a window. The window size can be based on seconds or number of data points. Increasing the size of the window increases the level of smoothing.

The **Fast Fourier** option takes out all frequencies which have a shorter wavelength than the box size set in points or seconds.

The **Threshold** option sets the cut-off value as a multiple of the standard deviation. The cut-off value is applied to the difference data.

The **Difference** between the filter line and the sensor data is then calculated. This difference will be greater in areas in which local variability is high. Any difference values outside of the threshold limit will be rejected with interpolation.

Filtering can be applied in three ways: either the present screen only, filter to the end of the line, or filter the whole line (outside Attitude Editor). Filtering can be applied with or without interpolation. As in Navigation Editor, sensor values may be **Queried, Accepted, Rejected** (with interpolation), or **Rejected** (break interpolation).

Exercise 45.

a. Highlight **Pitch** under **Data**, and enable **Filter / Smooth line** under **Show**.

b. Enable the **Filter** and **Smooth** checkboxes, choose the **Moving Average** option and increase the **Box Size** to **4** seconds.

c. Enable the **Difference** (yellow line) and **Threshold** (red line) options under **Show**.

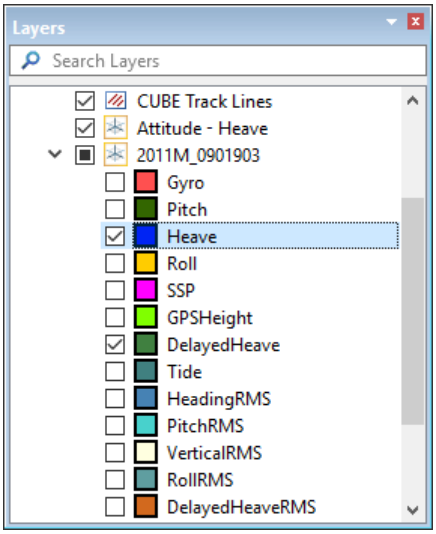
d. Decrease **Threshold** to **0.1** sigma.

e. Filter data with the **Filter 1 Screen** icon to apply this filter to the data.

f. To show rejected data enable the **Display filter** icon, then select the down arrow and enable the **Rejected** checkbox, to see any rejected data (grey soundings).

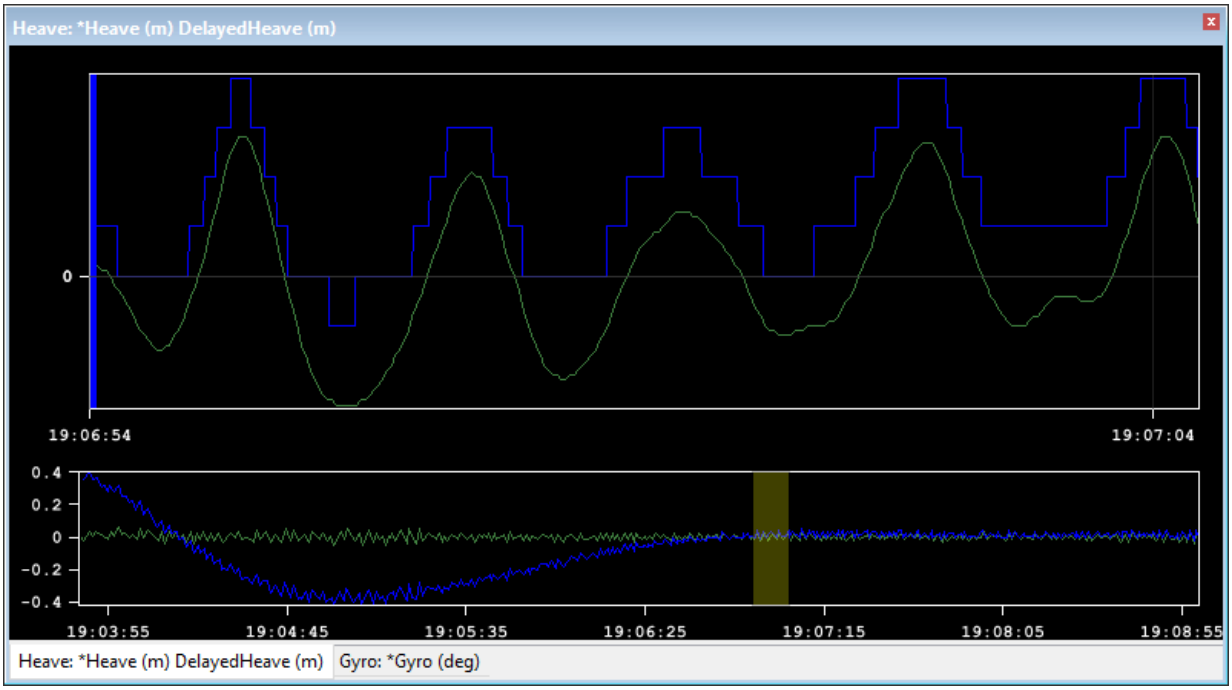
g. Undo the Changes with the **Undo** icon, or **Edit > Undo** menu.

Now two Heave data sources can be examined and compared, to evaluate which data source would be the more appropriate to apply to the dataset under investigation.



Exercise 46.

a. Under **Attitude - Heave** layer within the **Layers** window, enable both the **Heave** and **DelayedHeave** checkboxes. Note the smoothed post-processed Delayed Heave data.



b. Exit **Attitude Editor** and don't **Save** changes.

After exiting out of Attitude Editor and saving changes, the line will show up as out-of-date (with a red exclamation point next to it). Additionally, the surface itself will show up out-of-date. If you are making changes to the motion sensors or if there is a need to apply a smoothing coefficient, then the line must be SV Corrected again in Georeference Bathymetry and the surface recomputed.

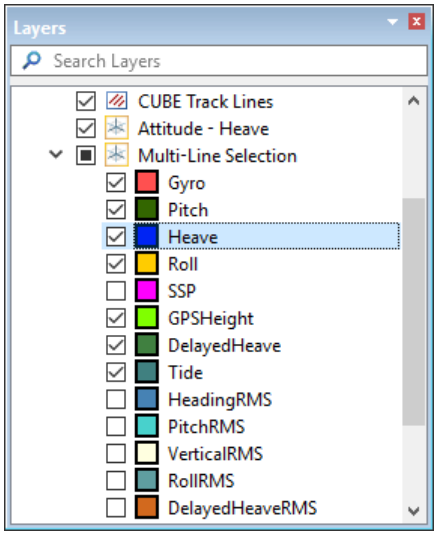
Attitude Editor also supports viewing multiple lines at the same time.

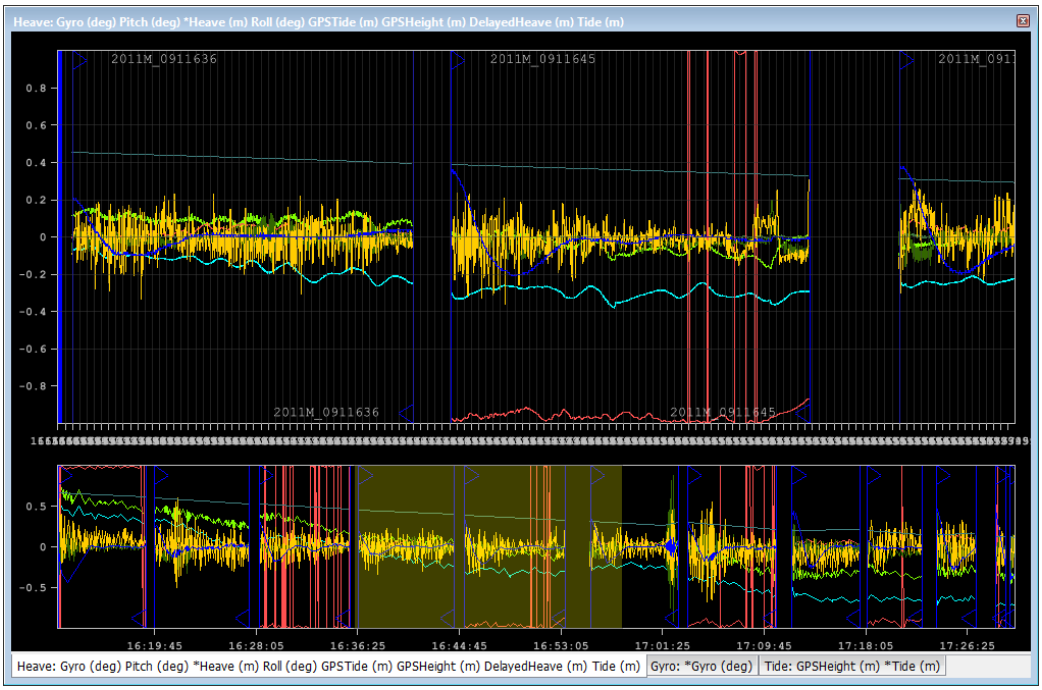
Exercise 47.

a. Within the **Active Track Lines** window select **Day = '2011-090'**.

b. Click the **Attitude Editor** icon or go to **Tools > Editors > Attitude > Attitude Editor…** menu.

c. Select the **Heave** window and enable the following sensors: **Gyro, Pitch, Roll, GPSHeight** and **Tide**.





d. Exit **Attitude Editor** and don't **Save** changes.

Swath Editor

During data import, the original data file is separated into a number of distinct files, each storing a different type of information, all of which are related by time. One of these files is the Observed Depths file, this file contains measured single beam, sweep, or swath soundings as reported by the data acquisition system.

Swath Editor is used to view and edit the multibeam swath data. This can be either a manual process or a semi-automated one using filters based on knowledge of the data. Swath Editor

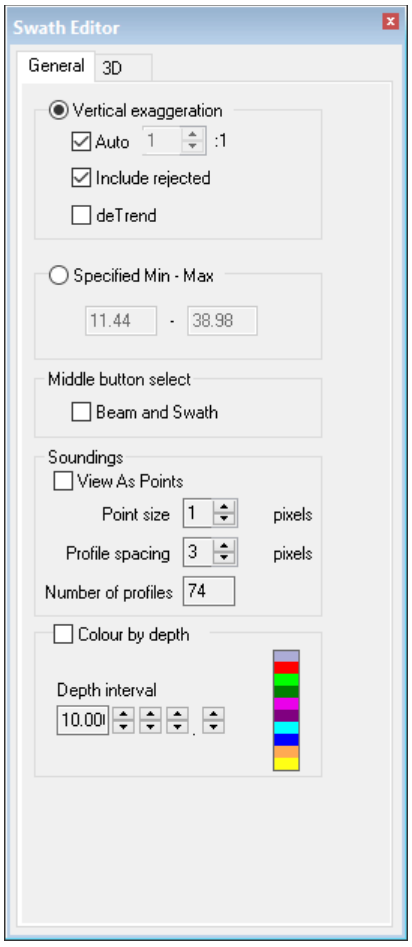
displays the contents of the file for sweep and swath systems in the Display window in graphic form so you can perform cleaning and filtering operations on the data.

Swath Editor controls are displayed on a new Swath Editor window. These consist of sub-panels that are used to manipulate the data in Swath Editor.

Exercise 48.

a. Select the line **2011M_0901903** in either the **Active Track Lines** or the **Display** window.

b. Click the **Swath Editor** icon or go to the **Tools > Editors > Swath > Swath Editor…** menu.



Swath Editor has several windows. Each of these can be opened using the Swath Editor toolbar.

- **Plan View** - Displays the beams and swaths in Plan View. The bottom of the display is the start of the line. The scroll bar can be used to page through the data.

- **Rear View** - This is the data displayed in the Plan View window viewed from the rear of the ship.

- **Side View** - This is an along track profile of all the swaths in the Plan View viewed from the starboard side, so that forward is to the right of the window.

- **Profile View** - This view represents a single swath at a time viewed from the rear. The scroll bar can be used scroll through the individual profiles.

- **Amplitude** - If the sonar data contains intensity information then it can be displayed in this window. This view can assist in feature recognition.

- **3D View** - In addition to image manipulation in the 3D View, the data can be selected, rejected, queried and accepted.

- **Port and Starboard** - Allows to select to view port and starboard beams together or separately

- **Filter Observed Depths** – Opens a pop-up dialog box to configure the filters to be applied to Observed Depths.

The various Swath Editor windows can be undocked. To move a window to another docked location, click the header and drag it.

The Swath Editor windows can be toggled on and off using the Swath Editor toolbar icons.

Vertical Exaggeration – This controls the amount of vertical exaggeration in the Rear, Side, and Profile views. There are options to automatically select the exaggeration to maximize the screen, to manually set the level, and to include the rejected soundings in the automatic selection if it is chosen.

The **deTrend** option is available to remove any persistent slope from data in the Rear, Side, and Profile views, making it easier to select soundings on a pronounced slope.

Specified Min – Max – Control the extents of the data to be displayed in the Swath Editor windows by defining minimum and maximum depth values.

c. Enable the **de-trend** option to remove slope from data.

d. **Disable** it when done.

e. Enable **specified min-max** and add **-30** and **50**. Re-enable **Vertical exaggeration** option.

Middle Button select – The middle mouse button can be used to select a swath in the Plan, Rear, and Side views. When this option is selected, it can also be used to select by beam in the Plan view.

f. Enable **Beam and Swath** then middle-click in the Plan View. Click the **Query** icon or press <**Q**> to view the selected beams in the Selection window.

g. Enable **View as Points** and increase the value of the **Profile Spacing** to **8** pixels to decrease the amount of data being viewed.

h. Return the **Profile Spacing** to **3** pixels.

Soundings – The Soundings options allow for the swath data to be displayed as points in the Side, Rear and Profile views. You may also specify the Point size and Profile spacing. The sounding size and profile spacing options control the displayed size of soundings and the distance between individual profiles. These values will change the amount of data that can be displayed in the Plan View window.

Colour by depth - This check box changes the sounding colours used to display depth in the Plan View and 3D View window. The Depth interval option changes the frequency of the colour change. If this is unchecked, the Plan View and 3D View windows will be displayed in the default mode, red for port and green for starboard.

i. Enable **Colour by depth** and change the **Depth interval** to **2.0**.

j. Uncheck the option **Colour by depth**, to go back to the default colouring scheme.

The **3D** View tab controls the 3D View window properties. The 3D View tab has several options available, including the display type choices. This function controls how the surface is displayed in the 3D View, and the choices are:

- Points
- Swaths
- Beams
- Swaths and Beams
- Surface

From the 3D View tab you can also enable/disable the display of the 3D View objects and manipulate the display of the view from the compass.

Swath Editor – Manual Selection

In the Swath Editor windows, soundings can be selected by dragging a box around the soundings with the cursor or by defining a lasso. The continuous lasso mode enables you to easily select and edit data in all data editors. When a sounding is selected it will appear red. A selected sounding can be given one of the following flags: Accept (or "**A**" key), Query ("**Q**"), Reject ("**R**"), and Reject Swath ("**S**"). These flags can also be accessed on the toolbar or by right-clicking and selecting the flag from the pop-up menu.

Exercise 49.
rree

a. With the **Select by Range** icon enabled, make a selection within the **Plan view**.

The space bar can be used to move along the line and <Ctrl> + Space bar moves backwards.

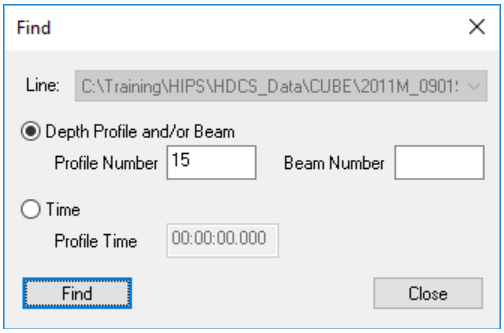
b. With the soundings selected click the **Reject** icon or select the (**R**) key from the keyboard.

c. To show rejected data enable the **Display filter** icon. Next select the dropdown menu and enable the **Rejected** checkbox, to see any rejected data (grey soundings).

d. To reaccept the data immediately, click the **Undo** icon or make the same selection and click the **Accept** icon or (**A**) key from the keyboard.

e. Enable **Auto Cursor Mode** and click the **Query** icon, then make several selections within the Plan window.

The Auto Cursor Mode function speeds up editing by automatically performing the set function on all soundings selected.



f. While in Swath Editor, click the **Find** icon or **Edit > Find…** (**<Ctrl>+F**) and enter **15** for **Profile Number**, click **Find**.

g. All Beams for Profile **15** will display in the **Selection** window.

h. Click **Close** on the **Find** Window.

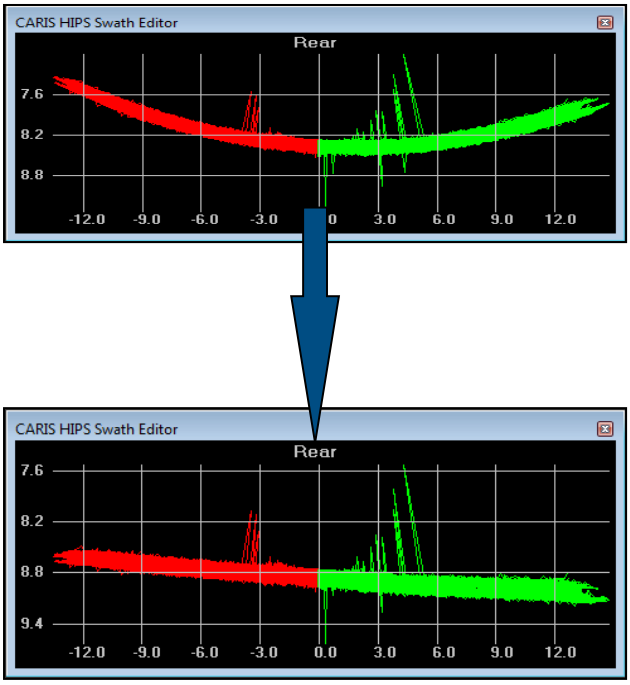
The **Find** function produces a window that enables you to search for a sounding or soundings by beam and/or profile number, or by ping time.

Note: Attitude Editor can be opened while working in Swath Editor by selecting **Tools > Editors > Attitude > Attitude Editor…** Opening Attitude Editor while in Swath Editor can be a useful tool for error assessment.

Refraction Correction

The **Refraction Editor** is a tool to remove refraction artifacts which may exist after incorrect or insufficient sound velocity (SV) profiles are applied in either the acquisition or post-processing phase.

When depth cleaning in swath editor, you can apply a velocity correction at a user-defined depth to remove the characteristic curved (upward or downward) refraction artifact. As you adjust values, you can see the change in shape of the swath profiles, as in the following illustration.



In the above example a SVP was applied during data collection which did not correctly describe the water column in the area of the survey, due to changes over time or distance. The resulting bottom depiction is a “smile”. In this case:

- Slower speed results in shorter distance travelled for same time period.
- Effect is more exaggerated in outer beams due to greater influence of ray-bending/refraction.

For correction purposes in the refraction editor tool, a constant SV is assumed. The constant SV is assumed to be 1500m/s and matching travel-times are calculated to represent the same bottom, that SVP represented.

A positive correction at the given depth will result in a flat bottom. Correction results in an upward ray deflection and an increase in distance travelled.

The **Refraction Editor** interface is activated from inside Swath Editor.

Exercise 50.

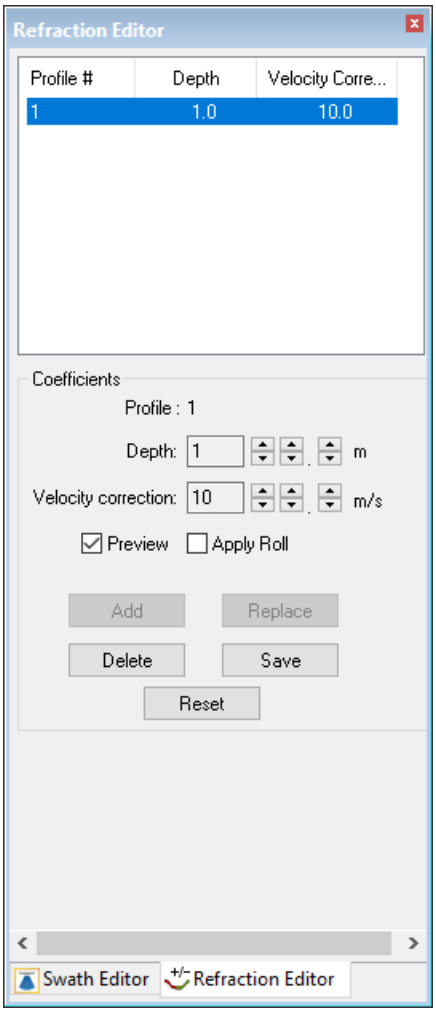
a. Select **Tools > Editors > Swath > Refraction Editor** from the main menu.

b. Enable the **Rear View**.

The **Refraction Editor** window opens, allowing you to make new entries using the controls as shown below.

- **Depth -** at which the velocity will be 1500m/s again.
- **Velocity correction -** the amount the velocity will change between the water surface to the given depth.
- **Preview -** shows the effects of the changes in the Swath Editor Rear View.
- **Apply Roll –** shows the effects of roll on the data. No change will be observed if SV Correction had previously been applied to the line.

The editor essentially compiles a list of swath (profile) numbers where the velocity profile changes. The depth and velocity correction values should be changed as necessary along the line; an interpolated value will be calculated and applied to each profile between two velocity correction entries.



c. Leave **Depth** value by default (approximately equal to Transducer depth).

d. Adjust the **Velocity Correction** as needed.

e. Enable the **Preview** checkbox to view the changes taking place in the Rear View.

f. Once a suitable value has been found click the **Add** icon, then click **Space** to continue through the survey line. Each time the values are changed click the **Add** icon. Once all the changes have been added for the line click the **Save** icon.

Changes are applied to the data during the **Georeference Bathymetry** step. A check box has to be selected for the coefficients to be applied. If the data has already been georeferenced, it will require re-georeferencing.

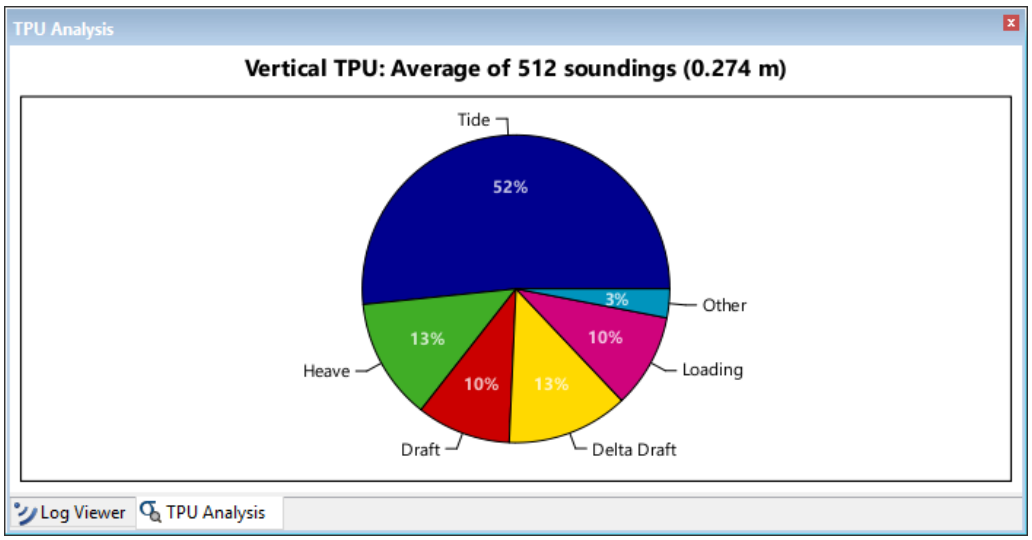
Note: The Refraction Editor does not in any way make up for taking the correct amount of SVP casts during a survey and should be used only as a last resort.

TPU Values

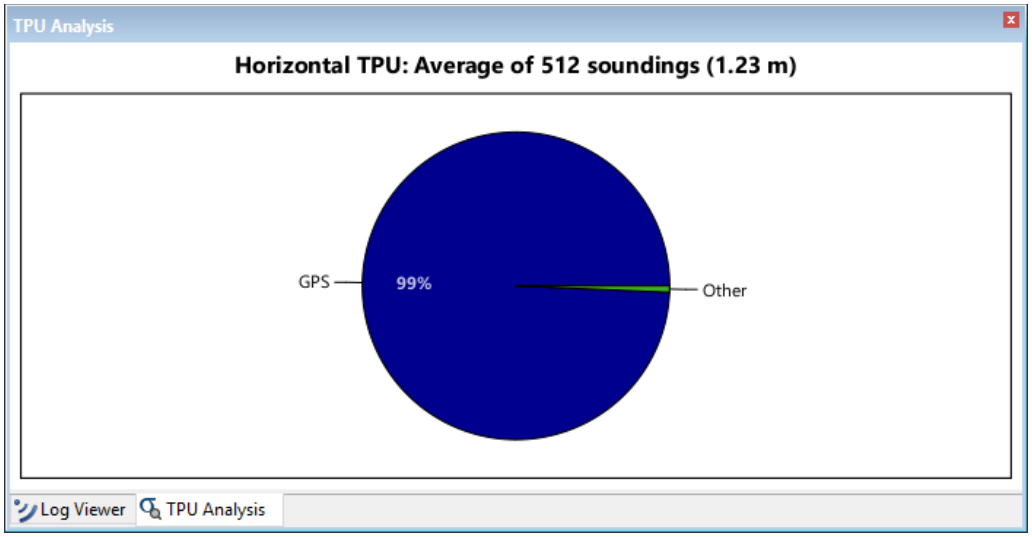
The TPU Analysis window enables you to visualize the proportional effect of the various

Uncertainty sources that make up the TPU Vertical and Horizontal. These component sources are displayed in pie chart, bar chart or scatter plot graphs.

g. On **Plan** view, select a whole swath using the middle button of the mouse, then the **TPU Analysis** window will be populated with the data related to the selected swath.



h. Select the **TPU Analysis window** to see the **Vertical TPU average** from the whole swath (512 beams).



i. Right-click on the **TPU Analysis window** and select **Horizontal TPU** to display it.

j. **Close** Swath Editor by clicking on the **Swath Editor** icon or by going to **Tools > Editors > Swath > Swath Editor**.

The IHO S-44 Survey Order achieved can be evaluated by hydrographers to assess if the survey accuracy requirement were met for this survey.

Observed Depth Filters

There are a number of ways to edit the swath data. The best method is to get a feel for the seabed topography using the Swath Editor views and the surface. Use the available information to determine some sensible Swath Editor Observed Depth Filters, which can then be run before going through and taking any remaining spikes out manually. Things to identify are rough values for minimum and maximum depths for the survey area as a whole. Make a note of the average swath width, which can be used in conjunction with the line spacing to determine what amount of overlapping data can be rejected.

Options

Accept Data: If this option is enabled, the logic filter will accept all the data following the criteria defined on the rest of the options. Otherwise it will reject all data (Disabled checkbox, value by Default).

IHO Order: It will test the TPU values against IHO S-44 or IHO-S-57 CATZOC minimum standards. You select the standard and the minimum order criteria that the survey must meet, or alternatively define values unique to the survey in question. The maximum acceptable uncertainty is calculated from the depth and specified order criteria, and the HIPS computed TPU values are then tested against these limits. Soundings with TPU values outside of the acceptable uncertainty will be flagged and will not be included in subsequent processes.

IHO S-44 (5th Ed.) Standards for Horizontal and Depth Uncertainties

Order	Special	1a	1b	2
Description of areas.	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but *features* of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Maximum allowable THU 95% *Confidence level*	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Maximum allowable TVU 95% *Confidence level*	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013	a = 1.0 metre b = 0.023

$$\pm\sqrt{a^2 + (b^2 \times d^2)}$$

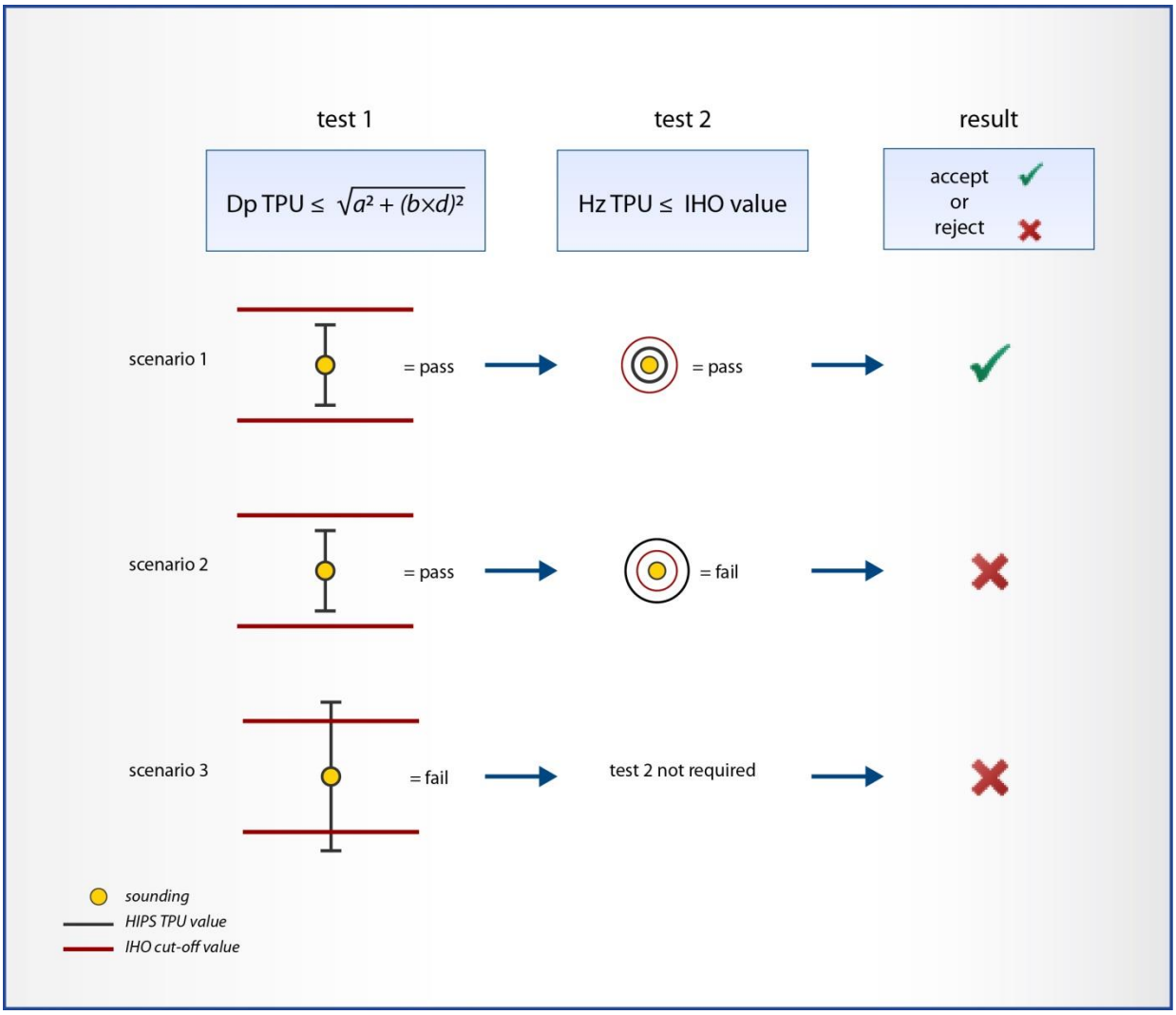
Where:

a represents that portion of the uncertainty that does not vary with depth

b is a coefficient which represents that portion of the uncertainty that varies with depth

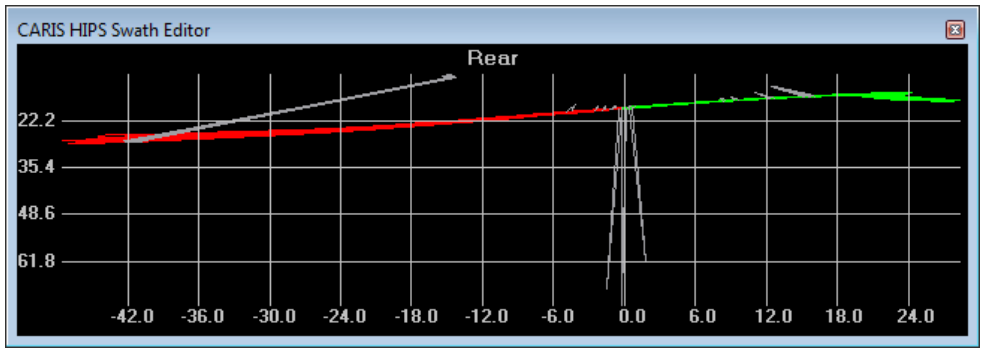
d is the depth

$(b^2 \times d^2)$ represents that portion of the uncertainty that varies with depth



Also if you select **S44 User Defined** or **S57 User Defined**, these options will become available:

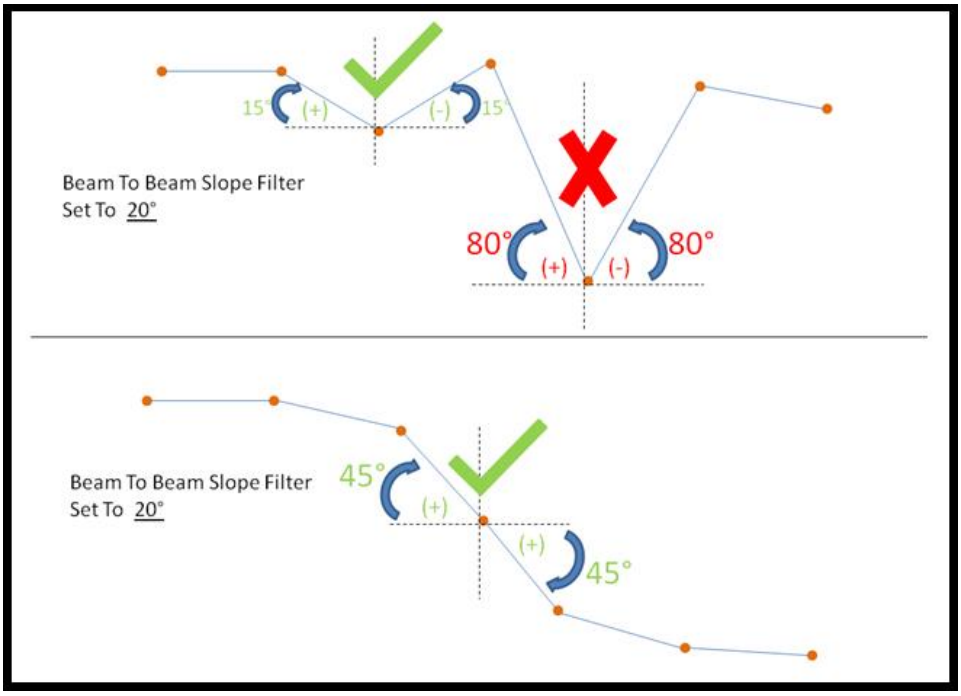
- **IHO Limits:** Defining new values for A and B
- **IHO Horizontal Distance Limit:** Where you can define new horizontal limits based on Horizontal distance and Percent value of Depth.



Filter Data: This filter is designed to reject soundings shoaler or deeper than the specified Minimum and Maximum Depth values.

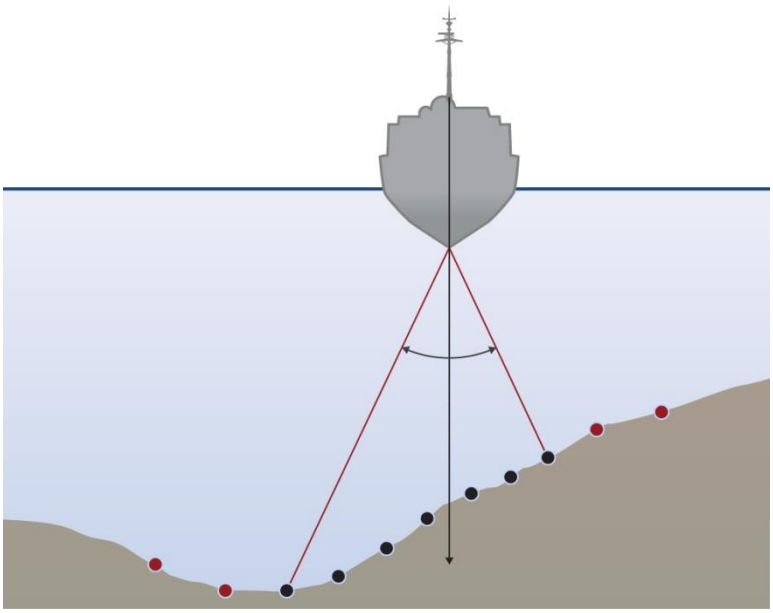
Swath Filters

Swath filters are applied to the observed depth data for each survey line.



Beam to Beam Slopes Across Track Angle: looks at the soundings either side of a sounding of interest and rejects the middle sounding if the slope angle to either side exceed the specified value and are of the opposite sign.

Note: It is possible to include already rejected beams in this calculation or leave them unconsidered. This becomes important when filtering is done repeatedly.



The following four filters are designed to flag soundings whose position in the swath is considered redundant based on the amount of specified overlap / coverage or beyond the acceptable limits of a system.

Across Track Distance: Soundings with across track distances from nadir that exceed the defined limit will be rejected. The result will be a swath width that is constant.

Across Track Distance Nadir Depth Multiplier: This filter rejects soundings for which across track distances exceeds a user defined Multiple of Nadir average Depth.

Beam Numbers: This filter will flag as rejected all the soundings coming from the beams or range of beams specified here.

Nadir Angle: is used to eliminate soundings at the outer edges of a swath. This is used:

- when the outer limits of the swath do not provide the required accuracy because of a higher occurrence of outliers or false detects, or
- in situations where the data has not been roll stabilized and a neat edge is required.

Reject Quality Flag: These flags are assigned to soundings in the acquisition system and can be used to flag potential outliers. Various sonar manufacturers assign flags to soundings during acquisition. The difference between them is the number and type of flags they assign, so you need to know their systems. The Brightness-Colinearity table shown below is specific to Teledyne RESON. As another example, Elac has flags for poor quality soundings as 3, up to a value of 1 as good quality.

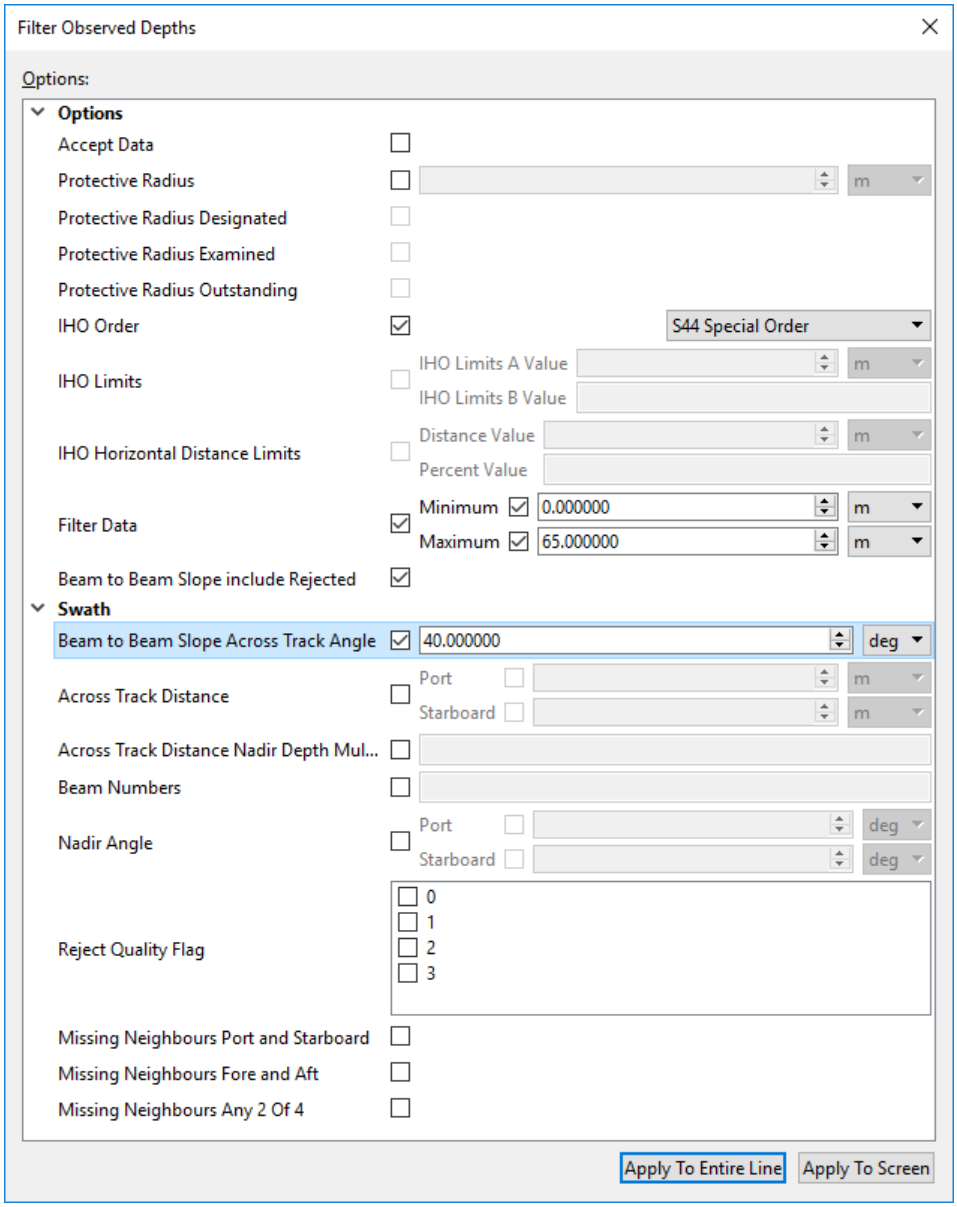
Quality	Brightness	Colinearity
0	Fail	Fail
1	Pass	Fail
2	Fail	Pass
3	Pass	Pass

Missing neighbours Port and Starboard - a beam is rejected if the beams on each side in the same swath are missing

Missing neighbours Forward and aft - a beam is rejected if the same beam in the previous and next swath are missing

Missing neighbours Any 2 of 4 - a beam is rejected if any 2 of the 4 neighbouring beams are missing

You will use the above information about filters to set up our own for these data. Make sure Swath Editor is open on a representative line. You will be testing our filters on one screen of the Plan view in Swath Editor before running the filters on the rest of the data.



Exercise 51.

a. Select the line **2011M_0901903** in either the **Project** or **Display** window.

b. Click the **Swath Editor** icon or go to **Tools > Editors > Swath > Swath Editor…** menu.

c. Click the **Filter Observed Depth** icon from **Swath Editor Toolbar** or go to **Tools > Editors > Swath > Filters…**

d. Under **Options** check the **Accept Data** checkbox is **disabled** (Filter will Reject Data).

e. Turn On the checkbox for **IHO Order** and select **S44 Special Order** from the drop list.

f. Turn On the checkbox for **Filter Data**. Turn on the checkbox for **Minimum** type **0**. Turn on the checkbox for **Maximum** type **65**.

g. Turn On the checkbox for **Beam to Beam Slope include Rejected.**

h. Turn On the checkbox for **Beam to Beam Slope Across Track Angle** and type **40**.

i. Click to **Apply to Entire Line**

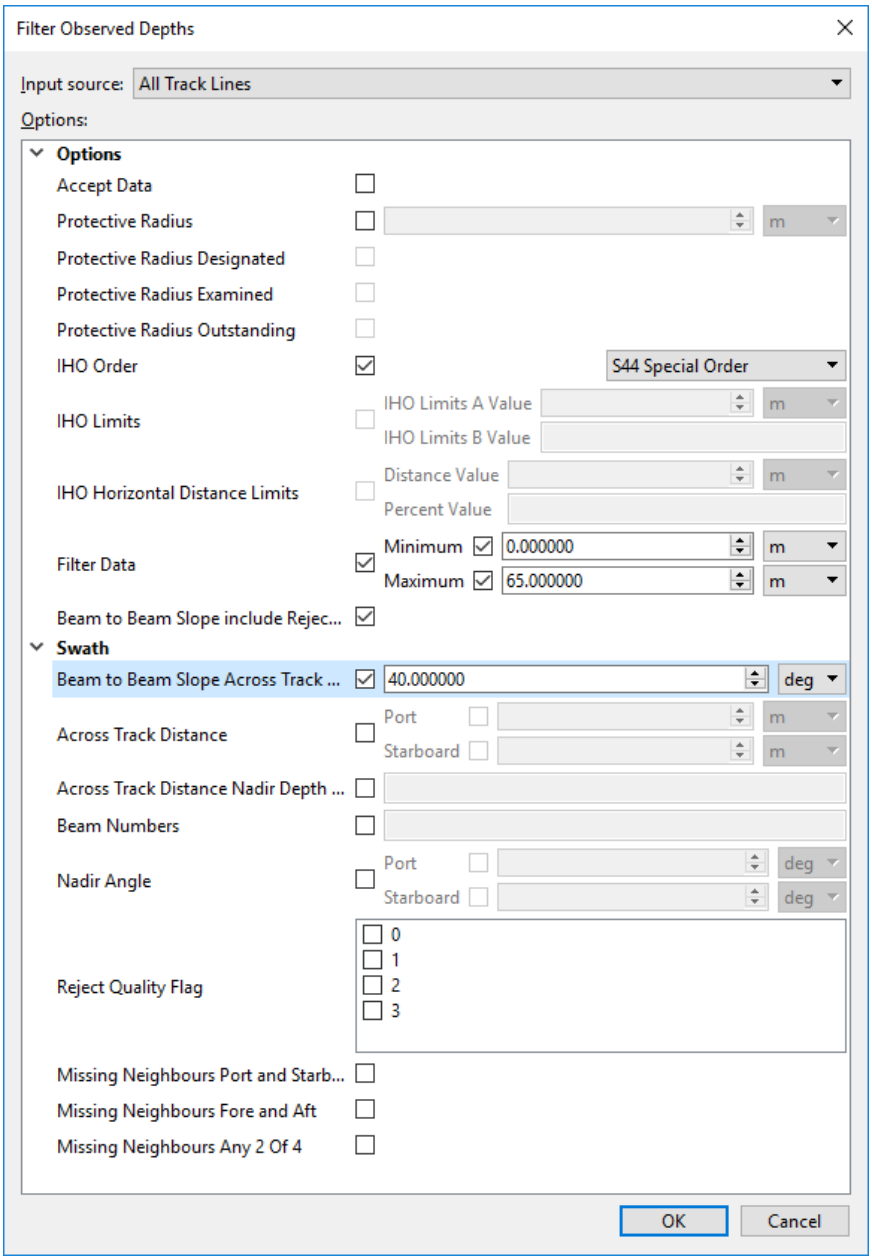
Note: Observed Depth Filter in Swath Editor can be applied to just the data in screen (**Apply To Screen**) or to the Entire Line (**Apply To Entire Line**).

When you are satisfied with the filter inside of Swath Editor, applied to this specific line(i.e. the data looks cleaner), then you can apply the same filter to all lines on a posterior exercise.

Note: The majority of data editing will be performed in Subset Editor, as you can visualize and compare multiple lines at once. If a feature appears in two overlapping lines of the same area, generally it can be considered a valid object; if it appears in only one line in an area of overlap, generally it can be considered noise and filtered appropriately.

You will run this final filter file on all lines. All the latest options used during filtering in Swath Editor will be remembered when running filtering for all lines.

j. Exit Swath Editor by clicking the **Swath Editor** icon, or go to **Tools > Editors > Swath > Swath Editor…** menu and **Save** the changes.



Exercise 52.

a. Click the **Filter Observed Depths Swath** icon or **Tools > HIPS Data Filters > Swath…** option from the main menu.

b. Check the **Input Source** is set to **All Track Lines** and that you have the same values as the Filter in Swath Editor. Click **OK**.

Attitude Filters

You can reject data with residual values that fall outside user-defined threshold limits, and apply these changes to attitude data across entire track line(s).

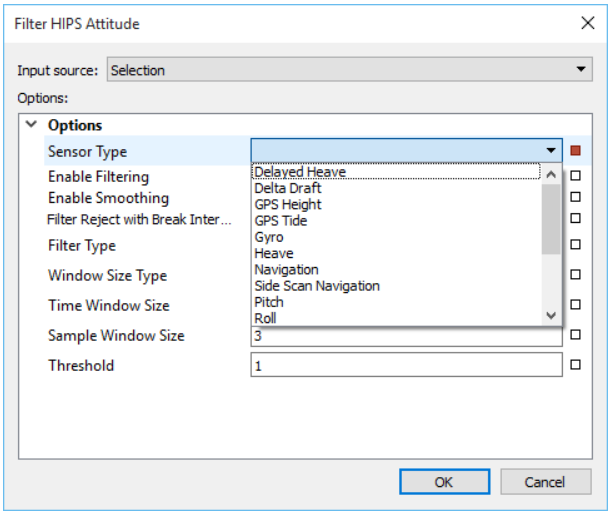
The Attitude filter can be used to accomplish two tasks:

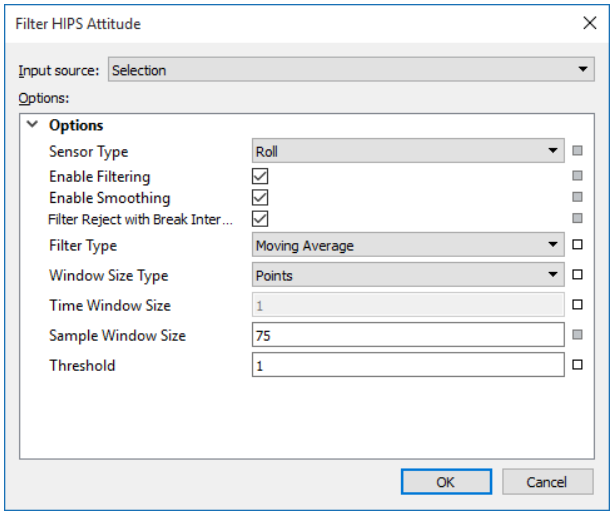
- **Smooth data**: The Smooth function is used to smooth out localized variability. The parameters for creating the smoothed **data** are saved to the **SmoothedCoefficients** file in the Line folder. This file is applied to the track line during any process that supports smoothing.

- **Filter data**: The Filter function is used to reject attitude that falls outside of defined boundaries. Soundings with the same time stamp as the rejected data are also flagged as rejected. You can choose to reject attitude data with interpolation.

Exercise 53.

a. Click the **Attitude Filters** icon or **Tools > HIPS Data Filters > Attitude…** option from the main menu.

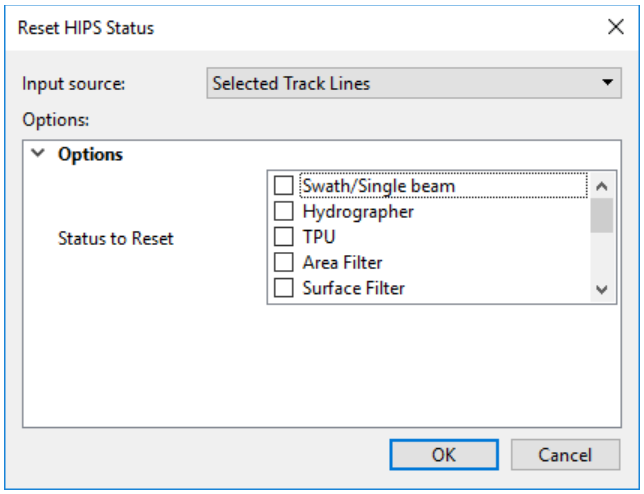




b. **Do not** select any options. You will not be applying this filter. Click on **Cancel**.

Reset HIPS Status

Edits made to the data using the various editing tools in HIPS can be undone by using the **Reset HIPS Status**.



During the editing process, soundings that are rejected also store the reason they were rejected. **Edit> Status Flag > Reset HIPS Status** can be used to undo specific types of rejection, based on this reason.

Filter Workflow Overview

Setting the filters is not typically a one-step process. You must determine acceptable filter settings for the particular dataset, test them and make the necessary adjustments before applying them to the entire data set. Below is a proposed workflow to maximize the filtering process.

- Locate an area with noisy data. This will be used as the test area. Examine the soundings and compare them to other areas with more acceptable data.
- Click the **Filter Observed Depths Swath** button from the toolbar and build a filter with settings that are appropriate for the data set.
- Click the **Apply To Screen** icon, to test the filter on the data currently displayed.
- If the desired results are not obtained, undo the filter by clicking the **Undo** icon.
- Adjust the filter settings and test it again.
- Once the filters have been properly set for that area, test the filters on other areas with noisy data.
- After all filter adjustments have been made, exit out of Swath Editor but do not save the changes. Select All Lines and click the **Filter Observed Depths Swath** icon from the toolbar to filter the entire data set.

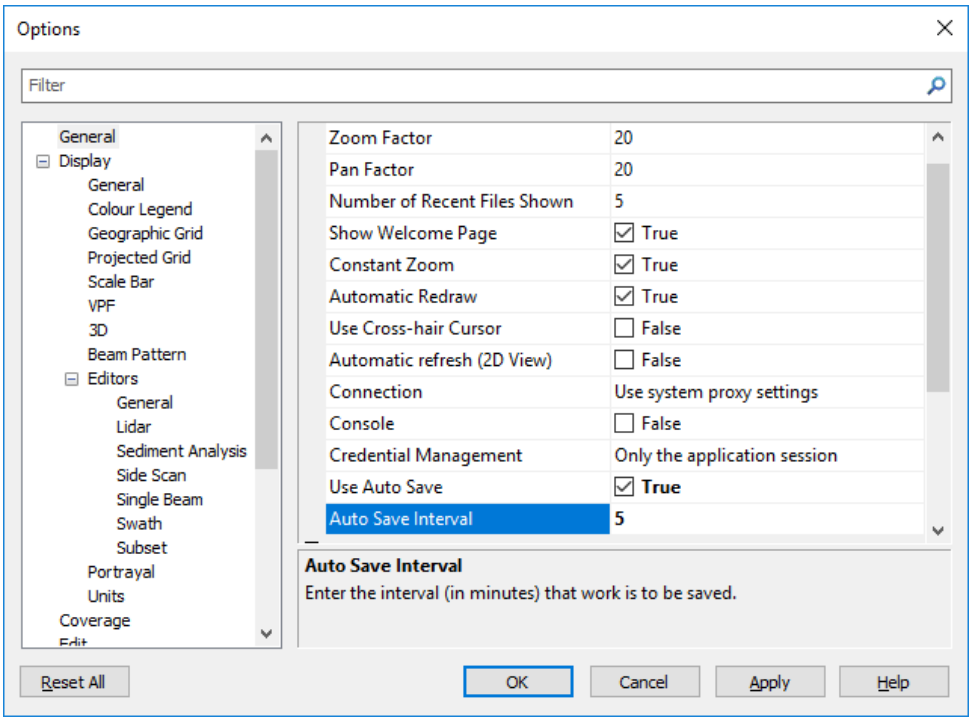
- **Recompute** the surface to view the changes. If the filters are still not set appropriately, undo the filtering process by clicking the **Restart Cleaning** icon in the main toolbar.

- If necessary, continue to adjust the filter settings until most of the noisy data is removed without rejecting valid data. This will minimize the amount of time required to perform manual edits.

Subset Editor

Subset Editor is an area-based editing tool available to use on georeferenced data. You will use the CUBE surface to perform a directed approach to editing data for sounding outliers which are apparent in the surface.

To further improve efficiency, HIPS will also maintain an up-to-date representation of the CUBE surface as sounding data edits are made using the area-based Subset Editor. With the Automatic surface update option enabled, when sounding edits are made in Subset Editor, a small area recompute will be performed on the surface. That is, only the surface nodes in and around the subset area will be recomputed when changes are saved.



- **Automatic refresh (2D View)** will redraw the 2D display window contents, automatically when changes are made to the data in one of the HIPS and SIPS Editors.
- The **Use Auto Save** function can ensure the changes are regularly saved within the Editors at a set interval. This option is shared by the Attitude, Navigation, Single Beam, Swath, and Subset Editor. You cannot undo anything previous to the last save.

The Subset toolbar contains the following functions:

- **2D** and **3D** windows can be toggled on and off.

- The **status of subset tiles** can be set to **Incomplete**, **Partially complete** or **Complete**.

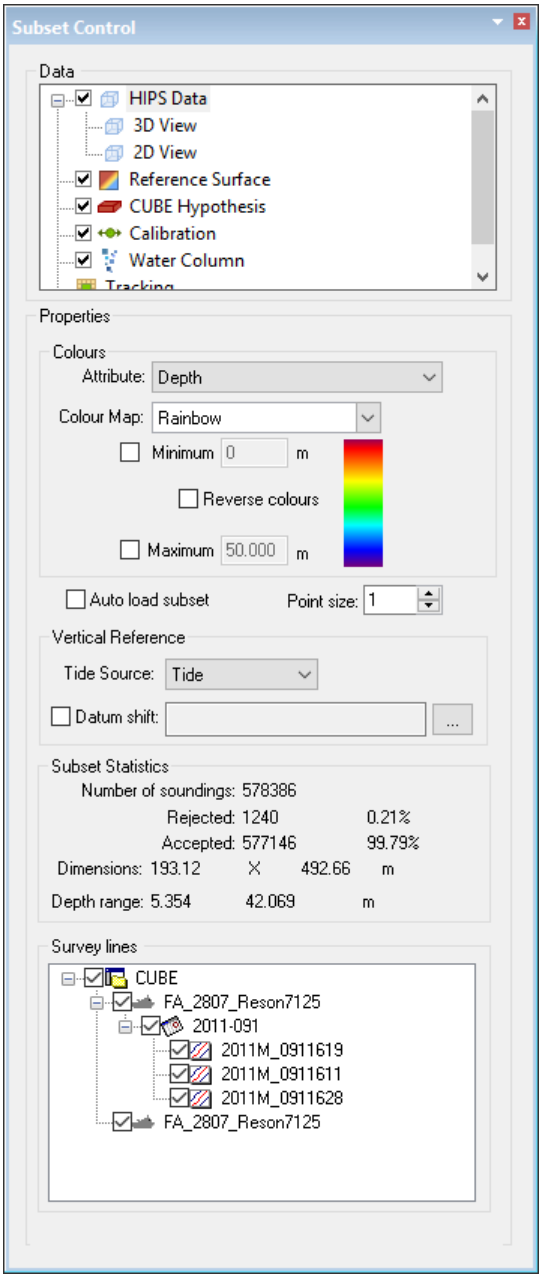
- If Auto load is disabled, you can first place the outline over the area to be edited and then either press Enter, select **Tools > Subset Editor > Load**, or click the **Load Subset** icon.

- The subset can be locked, so that the no accidental resizing, moving, and rotation can take place causing a redraw. The subset can also be locked by pressing the **<L>** key.

- **Surface Filter** can load any type of surface and apply filtering to the full subset or to the part of the surface within the subset 2D slice.

- **Subset Filter** will apply depth, beam number and beam-to-beam slope filters to soundings in Subset Editor.

The Subset Editor window has the various Subset Editor items organized into a **Data** tree. By selecting the items in the **Data** tree, the corresponding properties will be displayed in the **Properties** section of the **Subset Editor** tab.



The **Properties** available for the **HIPS Data** item include:

- **Colours** - Select an Attribute to be used to colour the soundings in the 2D and 3D displays. Depending on the selected attribute you may also be able to define the colours or colour map to be used for the display.

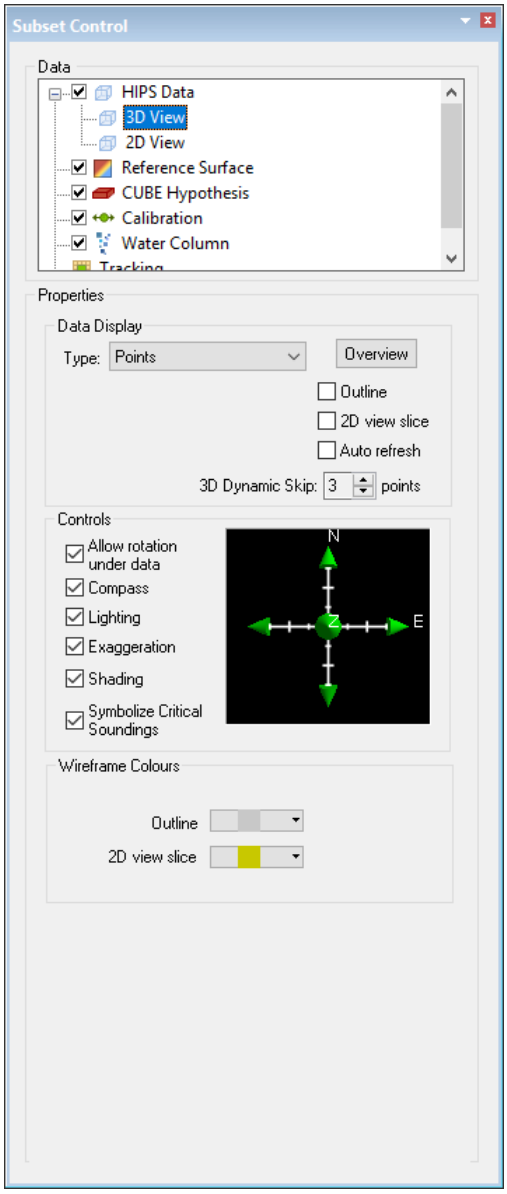
- **Auto load subset** - Automatically load the subset after moving, rotating or resizing the outline in the Display window.

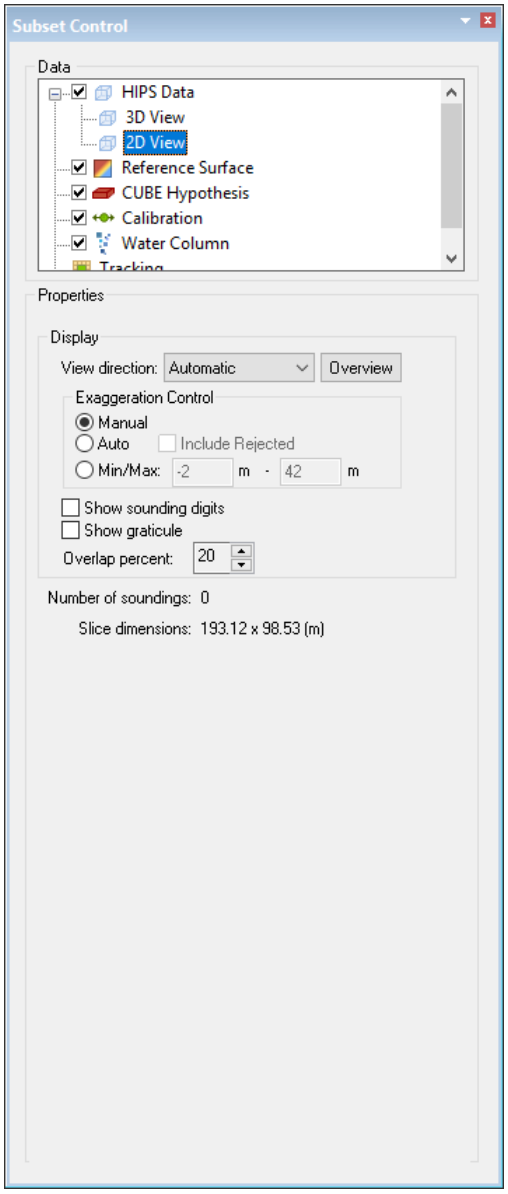
- **Point size** - Change the size of the soundings displayed in the 2D and 3D views.

- **Vertical Reference** - Data can be shifted vertically using either a tide or a currently open surface (.XYZ datum models can be open as Background Data) to visually change the data in the display. (No changes are made to the stored data.)

- **Survey lines** - Choose which lines are to be displayed in the View.

The Properties for the 3D View and 2D View can be accessed by selecting the respective items in the Data tree, as shown below.





Use the **Pan** (middle mouse button) and **Zoom in/out** (<Crtl> + right mouse button) on the **2D View**.

Other functionality includes:

- The **View Direction** of the data in the window is relative to the subset orientation. The yellow arrow on the subset outline in the Display points towards the top. The view direction should be selected with this in mind. Select **Automatic** to always have the 2D View display along the longest edge of the slice.

- Set the display by selecting **Auto Exaggeration**, **min/max** values or by adjusting it manually using the vertical exaggeration in the 2D View. You can also choose to **Include Rejected** soundings in the scaling. Soundings can be displayed as digits and graticule labels can be turned on and off.

The **3D View** is controlled in the same way as the 3D View for Swath Editor. There are however functions that are specific to Subset Editor.

The **Data Display** options allow for the 3D view display **Type** to be set as Points, Spheres, Cylinders, Surface or Surface Wireframe. The Subset **Outline** and **2D view slice** can also be enabled for display in the 3D View. **3D Dynamic Skip** reduces the number of points displayed while the 3D View is being manipulated.

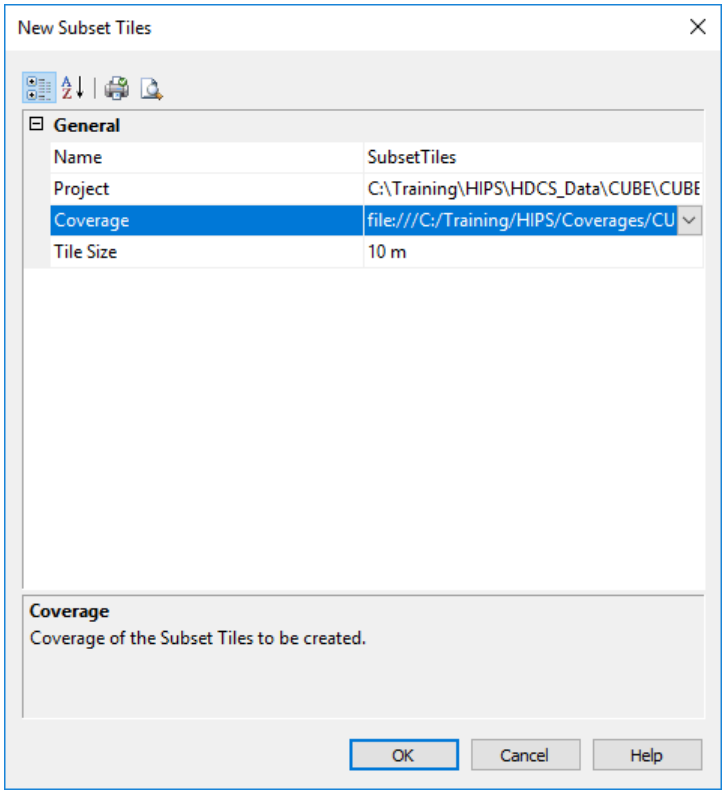
Under the **Controls** you can **Allow rotation under data**. This enables the operator to rotate the data beyond the horizontal and view the underside of the sounding data. The display of the Compass, Lighting and Exaggeration can also be enabled/disabled.

Subset Tiles

Subset tiles can be used to monitor and keep track of subsets, which have been cleaned.

Exercise 54.

a. . Select **File > New > Subset Tiles…** option from the main menu



b. Within the **New Subset Tiles** dialog box check that the **Project** is the current one and the **Coverage** is **CUBE_1m** surface. Enter a **Tile Size** of **10 m**.

The geographic extent of the tiles will match the extent of the surface. The tiles will have Cleaning Status and Last Modified attributes associated with them.

The Subset Tiles display options can be accessed in the **Properties** dialog box. You can specify display options such as colour maps and transparency values.

After the tile layer has been created, you can mark the Subset Tile layer using the icons on the Subset Editor toolbar. Tiles can be marked as:

Incomplete = red (status = 0) the beginning status.

Partially Complete = yellow (1) all tiles partially covered by a subset when it is marked as complete.

Complete = green (2) all tiles totally contained inside a subset when it is marked as completed

c. Select the **Subset Tiles** layer on **Layers** window and within the **Properties** set a **Transparency** of **50**.

d. **Refresh** the display window, and continue editing in Subset Editor.

e. Save the project by selecting **File > Save > Save Project…**

Area-based Editing

It will be necessary to make manual edits to the sounding data, but only in areas where CUBE was unable to properly select the estimates that model the actual seafloor. To highlight problem areas you will display the CUBE Hypothesis Strength or Count layers in the Layers window and display the CUBE surface as the Reference surface.

Data editing can be done in both the **2D View** and the **3D View**. Selecting soundings in one window will highlight them in the other window. Once soundings are selected the following functions become available on the Edit toolbar.

The options to edit selected soundings include the following,

- **Accept** - This works only on rejected soundings. To select rejected soundings, enable the Display filter icon. Next click the down arrow and enable the Rejected checkbox, thus allowing you to see any rejected data (grey soundings). Finally reaccept any rejected soundings.

- **Reject** - Flags the selected soundings as rejected.

- **Reject Swaths** - Even though this is not Swath Editor, it is still possible to reject the whole swath related to a selected sounding.

- **Outstanding** - Flags sounding for further examination.

- **Suppressed** - Set the status of soundings so that they are hidden or suppressed when creating a surface, or exporting the surface, but are not Rejected.

- **Examine** - Flags soundings that have been examined and verified.

- **Designate** – Flags the sounding as Designate.

- **Find Designate –** Looks on all the selected soundings and flags the shoalest one as a Designate.

- **Query** - Query the selected soundings.

Reject soundings only in areas where the CUBE surface has been incorrectly influenced. Rely on the CUBE surface layers to highlight areas that require investigation and possible edits.

Exercise 55.

a. Select the layer **CUBE_1m** on **Layers** window and on **Properties**, change **Colour By** to **Node_Std_Dev**.

b. Open **Subset Editor** by either clicking the **Subset Editor** icon or by selecting **Tools > Editors > Subset > Subset Editor…** option from the main menu.

The cursor in the Display window will change to crosshairs to define the outline of the subset to be edited.

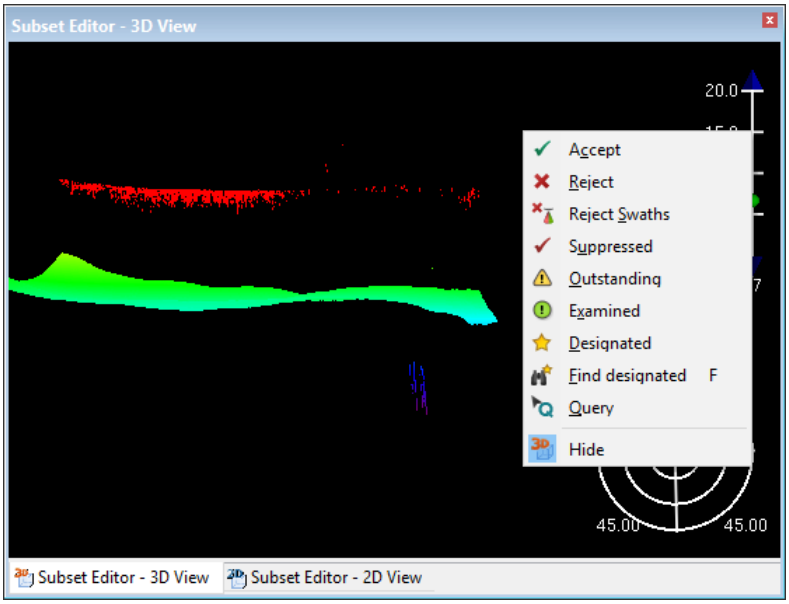
c. Define a subset area where the **Node_Std_Dev** values are higher (northeast area) by dragging a box around the data to be included holding the left mouse button. The subset outline can be rotated by holding down the <Ctrl> key while drawing.

d. The subset can also be resized by dragging the grey corner anchor points. Once is complete hit the **Enter** key on the keyboard or use the **Load** icon on **Subset Editor** toolbar, to load the data on the subset area.

e. You can also lock the selected subset area using the **Lock** icon on **Subset Editor** toolbar (optional).

f. The yellow 2D slice which controls the data being displayed in the 2D profile window can be resized or moved by dragging the yellow anchor points.

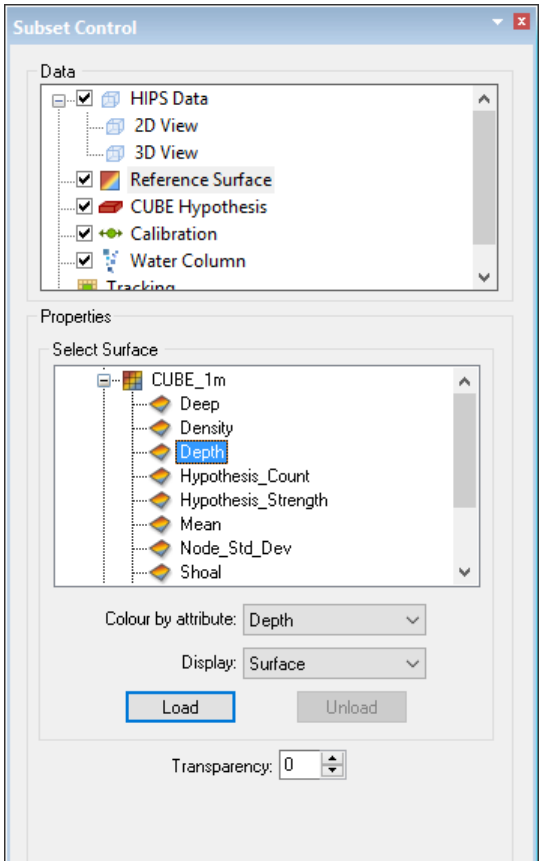
g. To move the 2D slice along the subset, use the keyboard arrows.



h. On the **3D View** user can rotate the view using the axis (X, Y & Z) arrows or holding the keys **Ctrl + Shift** and using the left button of the mouse simultaneously. Rotate the data until view is side view. Select all data above the seafloor (digital noise), right click and select **Reject** from the drop list.

Reference Surface

Surfaces that have been created during the HIPS workflow can now be displayed in the 2D and 3D Views of Subset Editor. The Subset Editor tab contains a **Reference Surface** item in the Data tree, as shown below.



Highlight the **Reference Surface** Data item to have the following Properties displayed:

Select Surface – Select a surface from any of the currently opened Projects.

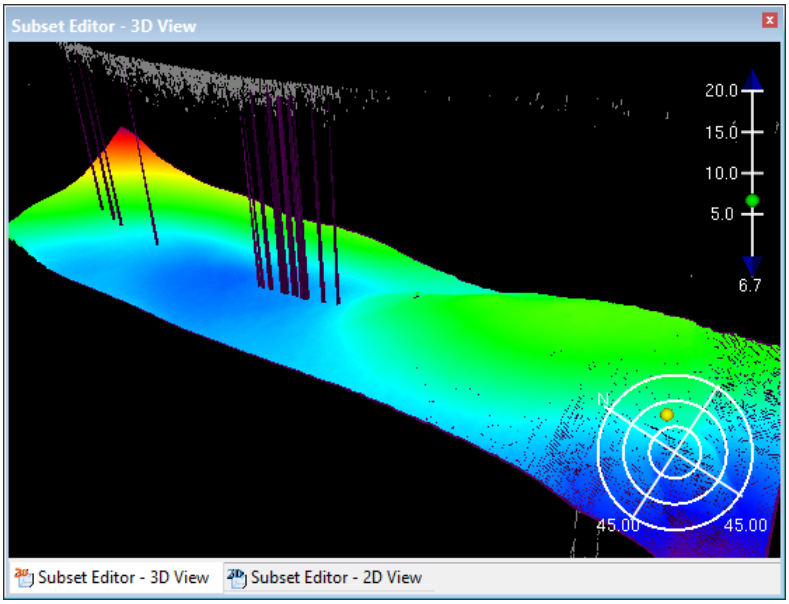
Colour by attribute – Choose any of the surface child layers to be used to colour the surface.

Display – Display the reference surface as points, surface or wireframe.

Transparency – Set a level of transparency for the display of the reference surface.

Load / Unload – Select Load or Unload to enable or disable the display of the selected reference surface.

The display of the reference surface in Subset Editor allows for a comparison of the sounding data to the selected surface. This enables you to evaluate how the soundings have contributed to the generation of the surface and identify areas where the surface may deviate from the processed depths.



i. Select **Reference Surface** from the **Subset Control** window.

j. Highlight the **CUBE_1m surface > Depth** Band under **Select Surface**.

k. Click **Load** and then view the reference surface in the 3D window.

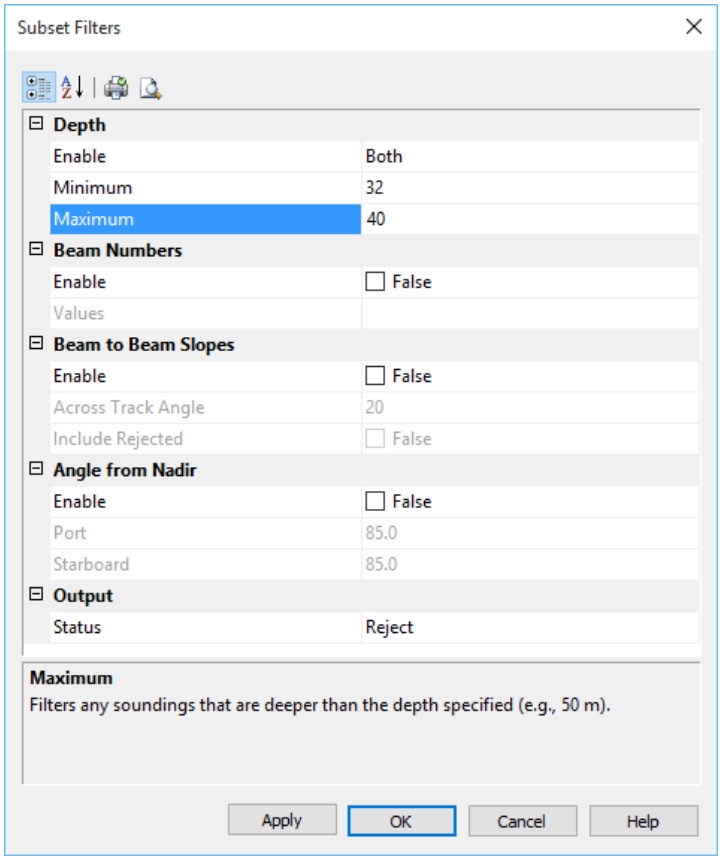
l. Click **Unload** to return to the previous view.

Subset Filters

You can apply these subset filters, to the specific subset Area, based on:

- **Depth:** Set minimum and/or maximum depth values to filter out soundings above and below the specified values.
- **Beam Numbers:** Filter single or multiple numbered beams.
- **Beam to Beam Slopes:** Slopes before and after a beam value across track are used to filter outliers.
- **Angle from Nadir:** Filter beams that are outside of the designated angles (e.g., 60 degrees) in the Port and Starboard side of the swath. Angles are computed from the nadir using depths and across track distances (roll-corrected).

Additionally, you can determine if the filter will Accept or Reject data in **Output**.



Exercise 56.

a. With the Subset Area open, click the **Subset Filters** icon from Subset Editor Toolbar or **Tools > Editors > Subset > Filters…** from the main menu.

b. On the **Subset Filters** window, change the **Depth** to **Enable: Both** and the **Minimum** to a depth deeper than the minimum on the Subset Area, **Maximum** to a depth shallower than the maximum on the Subset Area, and the **Output** to **Reject**. Click **OK.**

Notice how the filter was applied to the whole Subset Area

c. Open the Subset Filters dialog box again selecting **Tools > Editors > Subset > Filters…**or the **Subset Filters** icon.

d. On **Output**, change to **Accept**. Click **OK.**

See how the rejected data is re accepted again.

e. Click the **Complete** button from **Subset Editor** Toolbar or **Tools > Editors > Subset > Complete…** option.

See how the Complete status affects the Subset Tiles.

f. Close Subset Editor by clicking the **Subset Editor** icon or selecting **Tools > Editors > Subset > Subset Editor…** option from the main menu. **Save** the changes.

g. If the **CUBE_1m** layer has an Exclamation mark, it means that it needs to be recomputed to apply the changes, so right click on that layer and select **Recompute** from the emerging menu.

See that all the spikes on that area (on Node_Std_Dev band) are gone. You can continue editing other areas checking this band.

m. In **Layers** window, disable the **SubsetTiles** layer. Select the layer **CUBE_1m** on **Layers** window and on **Properties**, change **Colour By** to **Depth**.

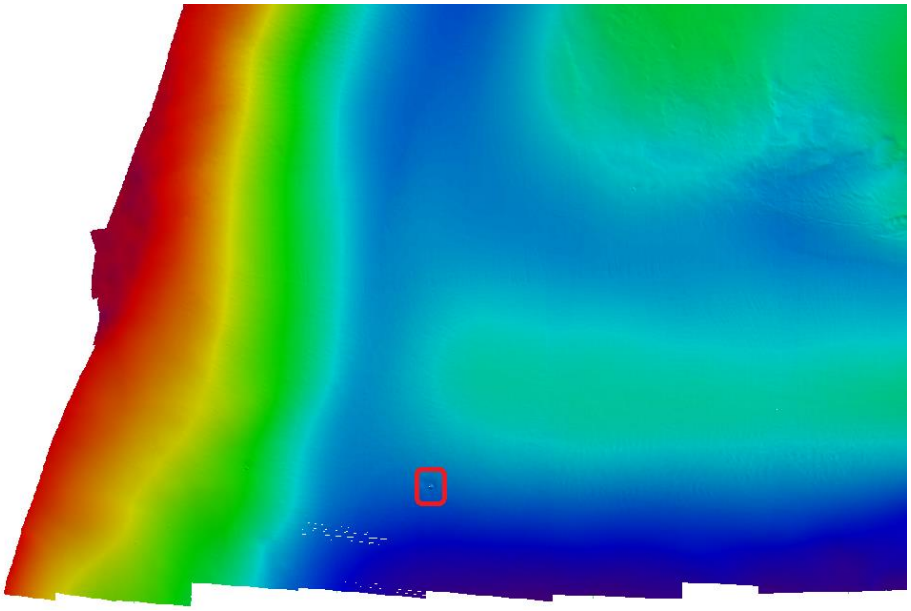
l. Save the project by selecting **File > Save > Save Project…**

Manual Designated Sounding Creation

You can give special status flags to critical soundings. In this exercise, HIPS will search a group of selected soundings for the shoalest value and assign it a quality flag of Designated. In this exercise you will use the **Find designated** option.

Exercise 57.

a. **Create** a subset around the obstruction in the southwestern area of the surface using **Subset Editor** icon, as outlined in the following image



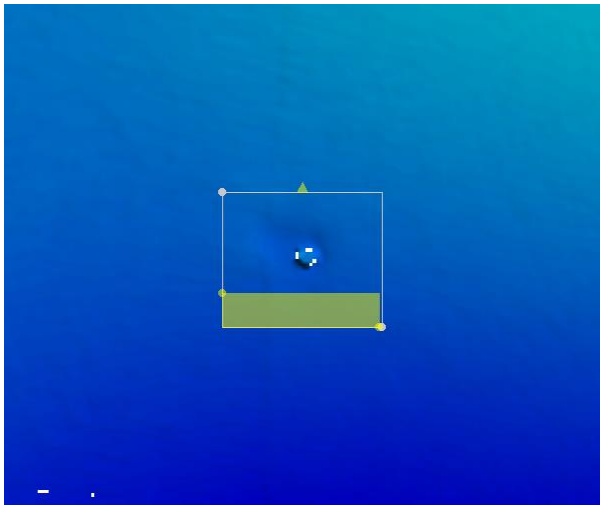
b. Load the subset with **Load** icon or hitting **Enter** from the keyboard.

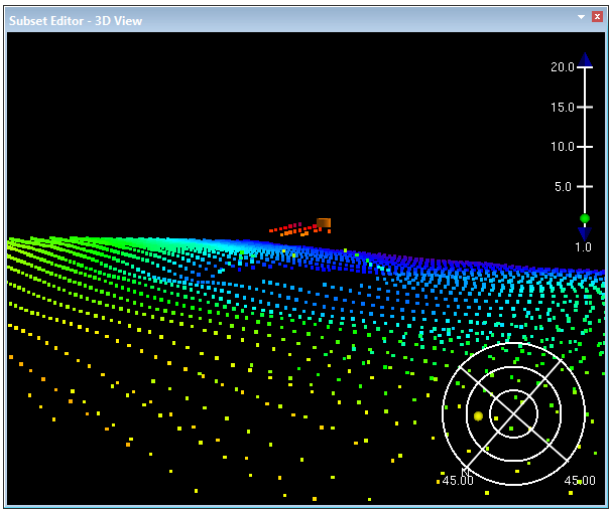
c. Choose the **Select by Lasso** icon and click the lasso around the outline of the wreck in the **3D view**. Press <**C**>, or right-click to close the lasso to select the soundings. The soundings selected by the lasso will be highlighted.

d. Click the **Find designated** icon, or select **Edit > Status Flag > Find designated** option from the main menu.

An orange disk will appear around the shoalest sounding within the selected group.

e. Select a group of soundings and include the designated sounding. Perform a **Query** by clicking the **Query** icon from the toolbar.

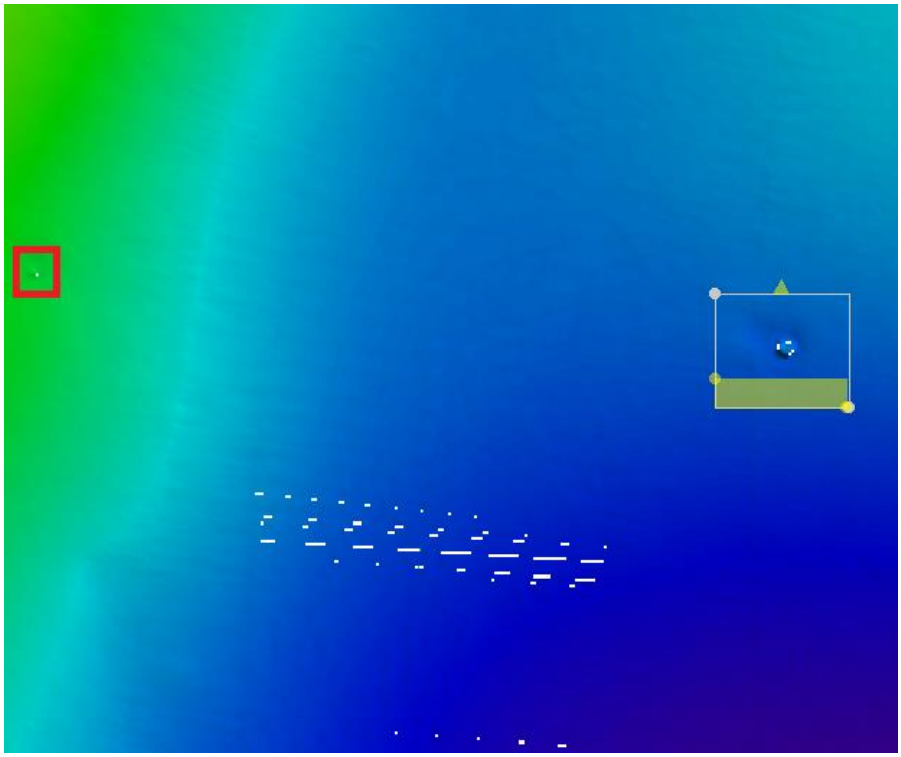




f. Double-click the **Status** column in the **Selection** window to bring the **Designated** sounding to the top, as shown below. Note the flag next to the sounding.

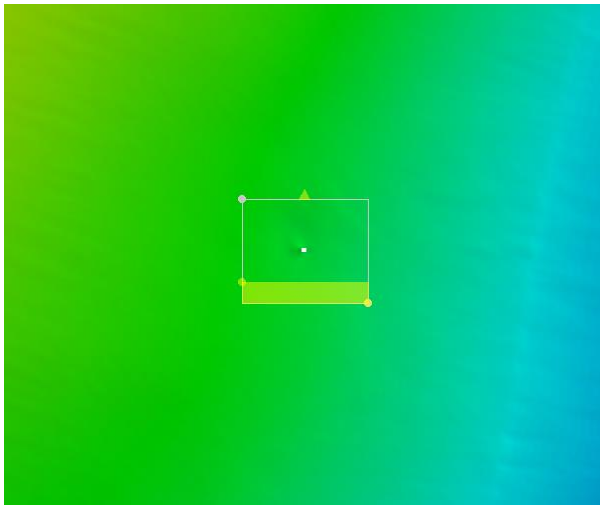
Lat (DMS)	Lon (DMS)	Project	Vessel	Day	Line	Profile	Beam	Time	Depth (m)	Status	Tide (m)	Dp TPU (m)	Hz TPU (m)
47-35-05.85N	122-35-17.89W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	163	90	2011-04-01 16:45:56....	46.189	Designated	1.386	0.329	0.164
47-35-05.89N	122-35-17.87W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	164	91	2011-04-01 16:45:57....	46.219	Accept	1.386	0.329	0.164
47-35-05.89N	122-35-17.86W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	164	92	2011-04-01 16:45:57....	46.275	Accept	1.386	0.329	0.163
47-35-05.85N	122-35-17.88W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	163	91	2011-04-01 16:45:56....	46.277	Accept	1.386	0.329	0.164
47-35-05.88N	122-35-17.85W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	164	93	2011-04-01 16:45:57....	46.336	Accept	1.386	0.329	0.163
47-35-05.85N	122-35-17.87W	CUBE81	FA_2807_Reson7125	2011-091	2011M_0911645	163	92	2011-04-01 16:45:56....	46.358	Accept	1.386	0.329	0.163

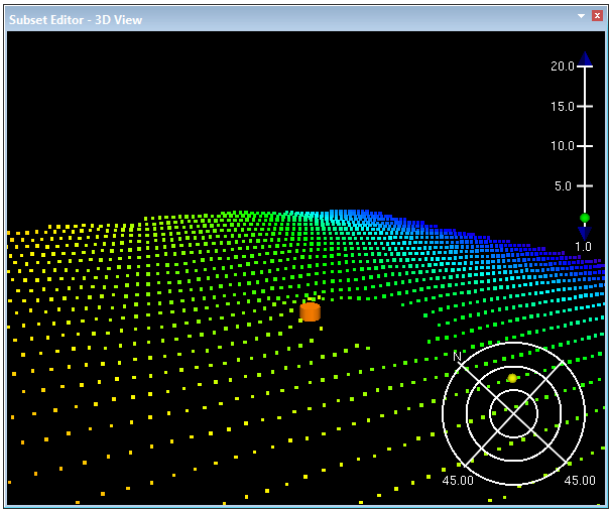
An area to the west has another sounding that needs to be designated.



g. Move the subset area by holding the left mouse button when you see a **four-arrow** icon over the current area. Release the mouse over the new nearby area. **Save** the changes.

h. The subset can be resized if required, finally load the subset with **Load** icon or hitting **Enter** from the keyboard.





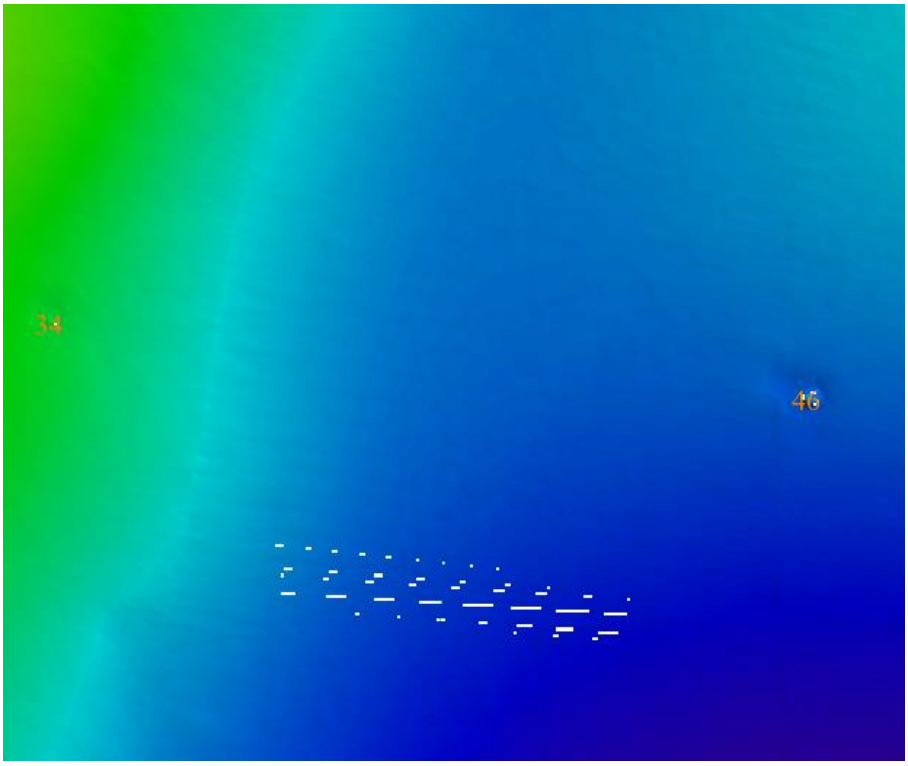
i. Choose the **Select by Lasso** icon and click the lasso around the outline of the wreck in the **3D view**. Press <**C**>, or right-click to close the lasso to select the soundings. The soundings selected by the lasso will be highlighted.

j. Click the **Find designated** icon, or select **Edit > Status Flag > Find designated** option from the main menu.

The designated soundings will be used when creating the **Finalized Surface**, ensuring the shoalest soundings will be honoured in any final bathymetric products.

k. Close Subset Editor by clicking the **Subset Editor** icon or selecting **Tools > Editors > Subset > Open…** option from the main menu. **Save** the changes.

Once designated soundings have been created, they can be viewed by enabling the layer **All Critical Soundings** layer on **Layers** window.

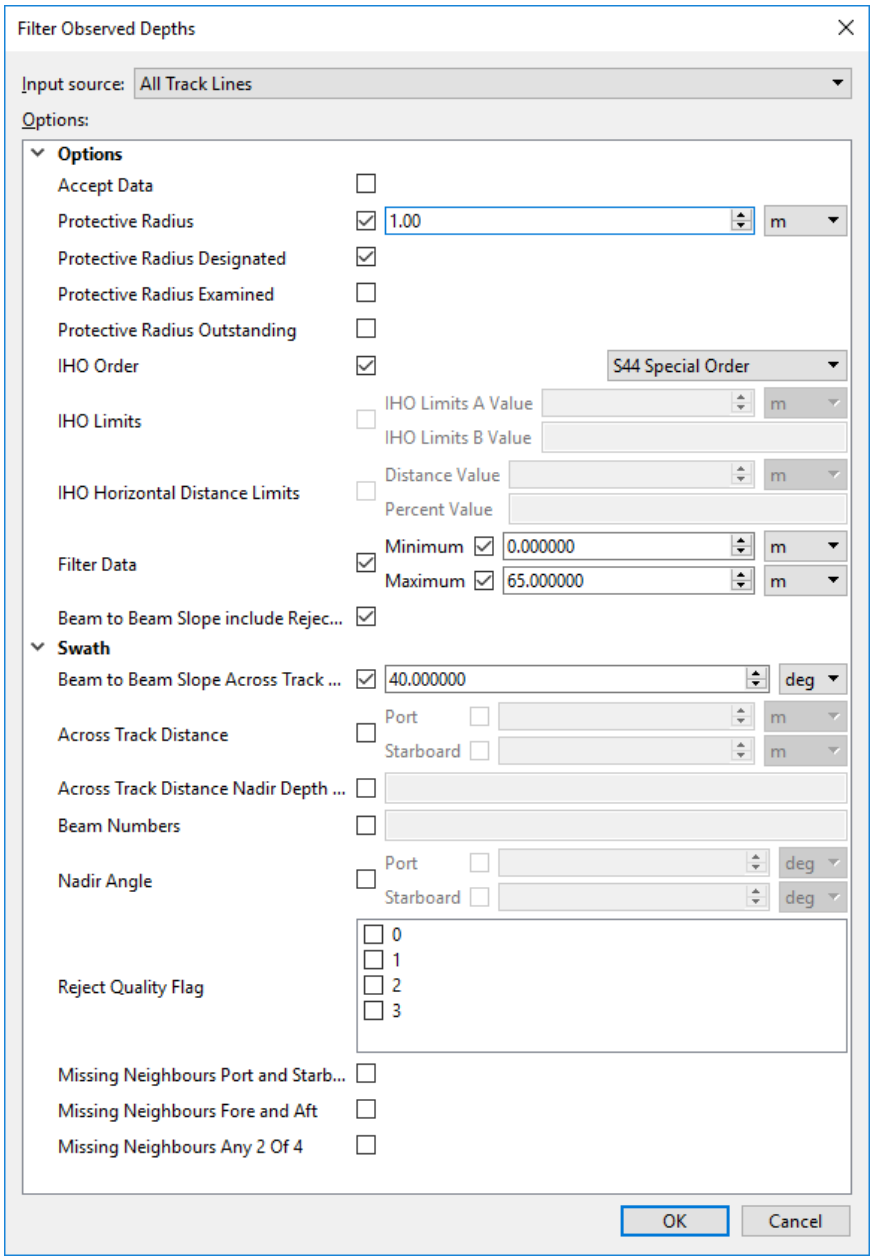


l. Turn on the **All Critical Soundings** layer on **Layers** window and move it to the bottom of the list

m. Save the project by selecting **File > Save > Save Project…**

Set Filters – Protect Critical Soundings

A protective radius filtering option allows soundings close to Critical Soundings to be protected from all automated filters.



Exercise 58.

a. Click the **Filter Observed Depths** icon or the **Tools > HIPS Data Filters > Swath…** option from the main menu.

b. Under Options turn on the checkbox for **Protective Radius** and type **1**

c. Turn on the checkbox for **Protective Radius Designated.**

d. Click **OK**.

Note: The Protective Radius only applies to filters applied at the time the option is set. It will not re-accept data rejected by previous executions of the filters.

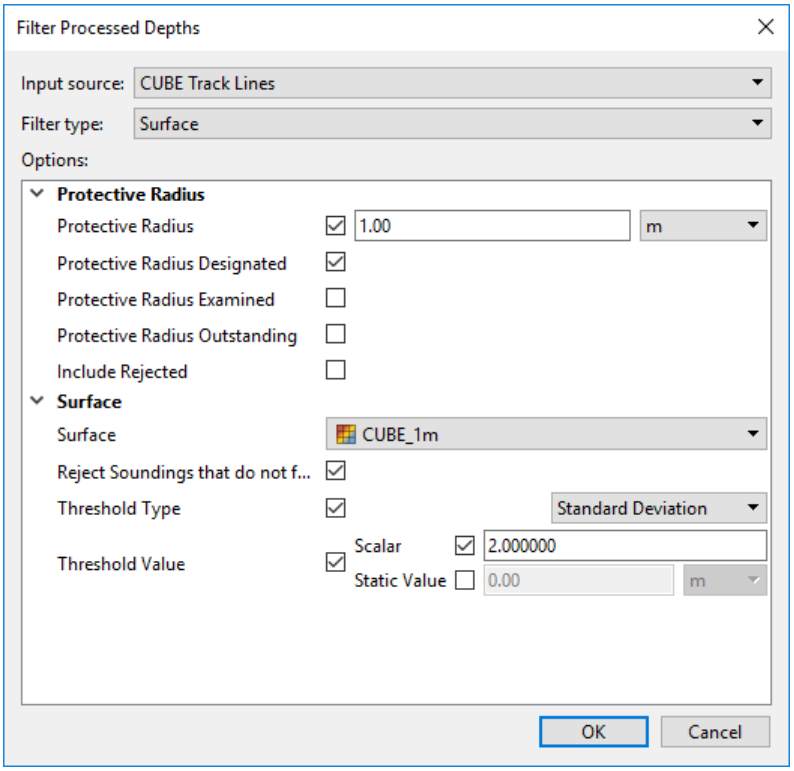
Surface Filter (Filter Processed Depths)

After the necessary manual edits have been performed, the surface has been updated and the CUBE surface is modeling the correct sounding data, you can filter the remaining erroneous multibeam sounding data against the CUBE surface using the Surface Filter.

Exercise 59.

a. **Recompute** the **CUBE_1m** surface (See out-of-date flag (**!**) displayed within **Layers** window), making right click on the layer and select **Recompute** from the drop list or select the **Recompute** icon from toolbar.

b. Highlight the **All Track Lines** layer in **Layers** window and within the **Project** window select the **Track Lines** layer. Then select **Tools > HIPS and SIPS > Data Filters > Processed Depths (Surface/Polygon/Noise Confidence)…** from the main menu.



You can reject soundings that deviate from the CUBE surface using a source of uncertainty values and a specified threshold.

c. On **Input Source** select **CUBE Track Lines** from the drop list.

d. On **Filter Type** select **Surface** from the drop list.

e. Enable the **Protective Radius** checkbox and set the value to **1 m**.

f. Enable the **Protective Radius Designated** checkbox

g. Select **CUBE_1m** form **Surface** drop list.

h. Enable the **Reject Soundings that do not fall on the Surface** checkbox.

i. Enable the **Threshold Type** checkbox and select **Standard Deviation** from the drop list.

j. Enable the **Threshold value** checkbox and enable just the **Scalar** checkbox, and set the value to **2.0.** Click **OK**.

Soundings that deviate vertically from the surface by more than the surface uncertainty values displayed at the 95% confidence level will be flagged as rejected.

Note: It is possible to apply the Surface Filter for a second time with altered settings. You can select to **Include rejected** option, which will include soundings that were previously rejected and will be reaccepted back and considered for rejection based on the new settings.

Sounding data that did not contribute to the surface creation or does not have accepted nodes can also have the filter applied by selecting to **Reject soundings that do not fall on the surface**.

By applying the surface filter, you can greatly reduce the number of manual edits required by hydrographers to produce a clean sounding data set.

Recompute the Surface

Once you have finished editing the data in Subset Editor and closed the editor, or cleaned the bathymetry using the Surface filter, the surface may appear outdated. This is indicated by a red exclamation mark on the surface layer in the Layers window. The **Recompute** function enables quick recomputing of a surface to update any changes that have been made.

Exercise 60.

a. **Recompute** the **CUBE_1m** and **Seattle_VR** layers, making right click on each layer on **Layers** window and selecting **Recompute** from the drop list, or by click on **Recompute** icon from toolbar.

All changes made during the editing process are applied to the surface.

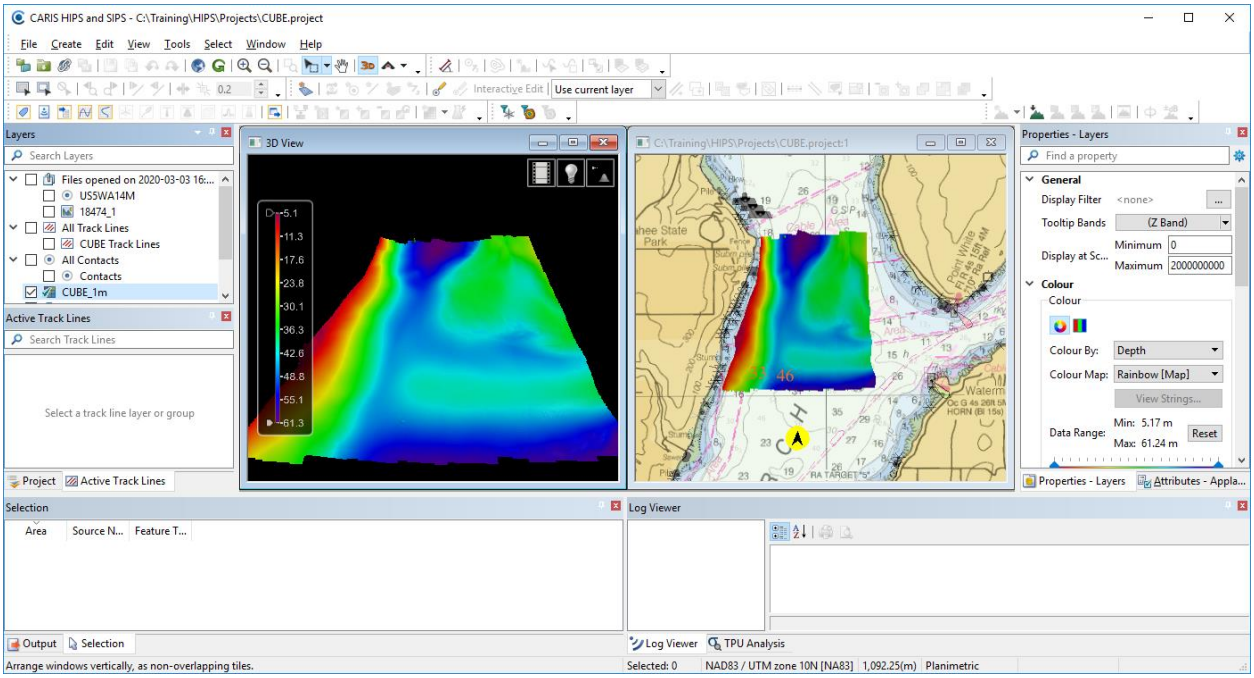
b. Save the project by selecting **File > Save > Save Project…**

3D Display Window

The 3D Display window shows project-level information in three dimensions. You can display various raster and vector data, navigate through the 3D environment, use playback functions, produce video recordings and access the HIPS Subset Editor. The 3D Display is a useful tool for visualization, selection and error detection.

Exercise 61.

a. Click the **3D View** window icon or select the **View > 3D View** option from the main menu.



b. Once the **3D view** Window is displayed, go to **Window> Tile Vertically**, to see (**2D** and **3D** views) both at the same time. Note that the **Properties** and Layers selected in **Layers** tab, change for each of the views.

c. In the **Layers** window, enable the **CUBE_1m** layer.

The 3D scene will be created. The 3D Display window tab will display the various Scene controls. To access the properties of any of the scene objects ensure that the Properties window is opened (**Window > Properties**) and select the desired layer from the list. From the Properties dialog box you can configure the data display.

Navigation Controls

The 3D Display window enables you to seamlessly navigate through the 3D scene and examine the data. To navigate through the 3D scene, you can rely on the three-button mouse or the graphical control panel.

You can navigate the 3D View using various keyboard shortcuts and mouse controls.

To navigate using the keyboard:

Key	Action
W	Pan forward in a straight line, horizontal to the terrain.
S	Pan backward in a straight line, horizontal to the terrain.
C	Zoom into the display.
V	Zoom out of the display.
↑	Pan up in a straight line.
↓	Pan down in a straight line.
←	Pan left in a straight line.
→	Pan right in a straight line.

To navigate using the mouse:

Mouse Button	Action
Left	Select points at the current cursor location. Press and hold while dragging the cursor to create a bounding box and select a group of points.
Right	Activate the Control Axes used to rotate the view.
Middle	Pan the display relative to the direction of the mouse cursor. The actual direction moved will depend on the Controller Type selected in Tools > Options. Scroll forward to zoom into the display. Scroll reverse to zoom out of the display.

The functionality of the right mouse button and the middle mouse button can be swapped using the **Swap Middle & Right Mouse Buttons** option in the **Display > 3D** category of **Tools > Options**. The options are:

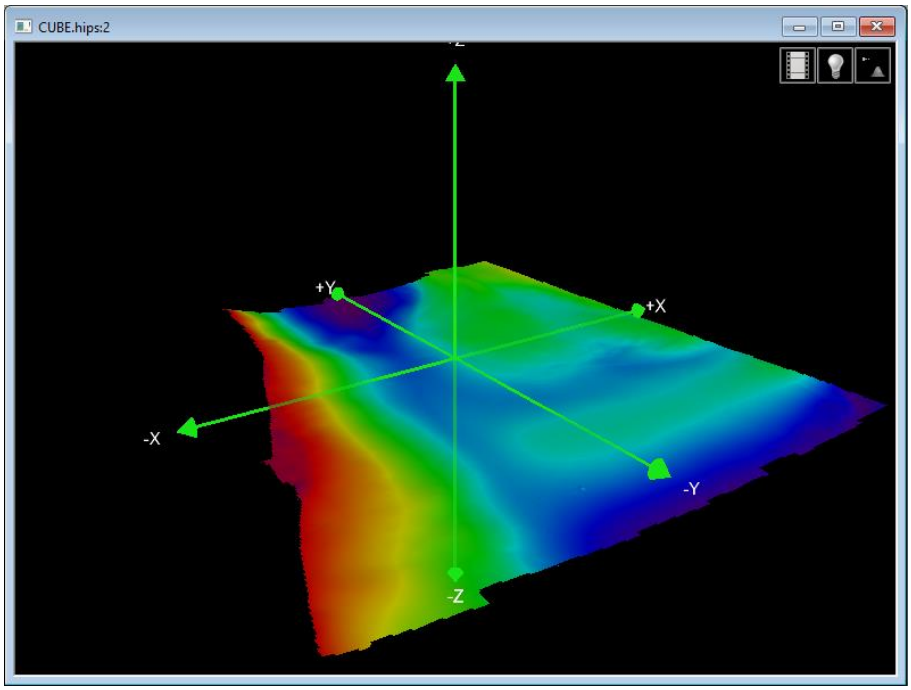
- • **False:** the default behaviour is used - the right mouse button provides the control axes functionality and the middle mouse button is used to navigate the view.
- • **True:** the behaviour of the buttons is reversed - the middle mouse button provides the control axes and the right mouse button is used to navigate the view.

When using the mouse to navigate, the speed you travel through the display or pan the view varies with the cursor's distance from the centre (stationary) point. Also, the type of adjustment applied to the view when using the mouse differs based on the selected **Controller Type**. The Controller Type controls how movements of the mouse will adjust the display. The Controller Type setting is accessible from the View menu or the Standard toolbar. There are three possible settings for the Controller Type:

- **Terrain Flyer (3D):** When this option is selected, the view is adjusted from the perspective of the height source.

- **First Person (3D):** When this option is selected, the view is adjusted from a camera view of the current display.

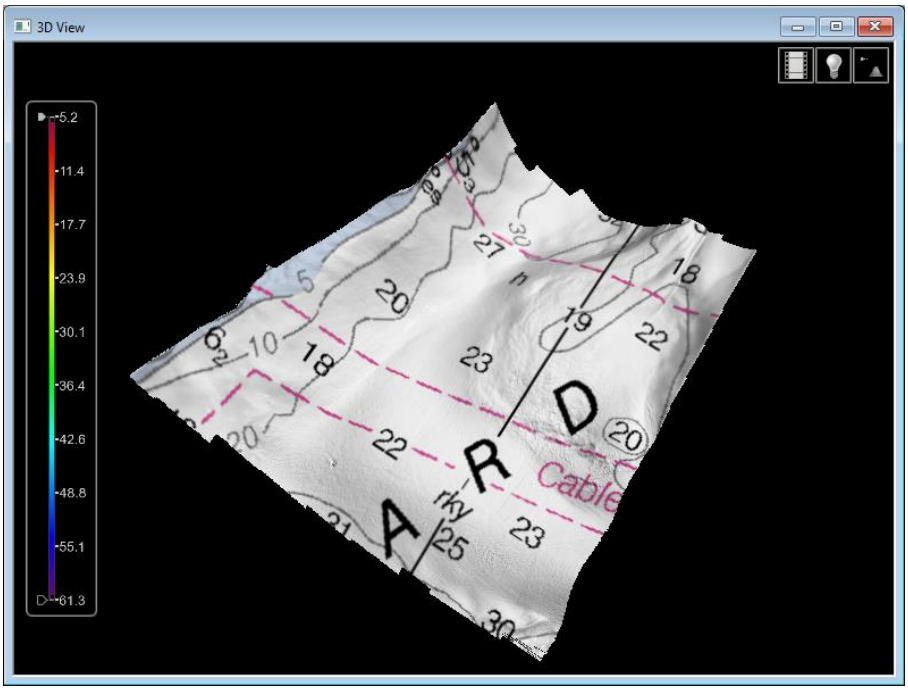
- **Move View (3D):** When this option is selected, the display can be panned in any direction by pressing and holding the mouse button while dragging the cursor.



- Click the right mouse button with the cursor over the terrain to access the terrain axis. You can then tilt and rotate the scene around the selected axis.

Use the mouse buttons and/or the graphical **Control Panel** to navigate through the **3D scene**. The **Tools > Options > 3D** tab can be accessed to change the mouse control options.

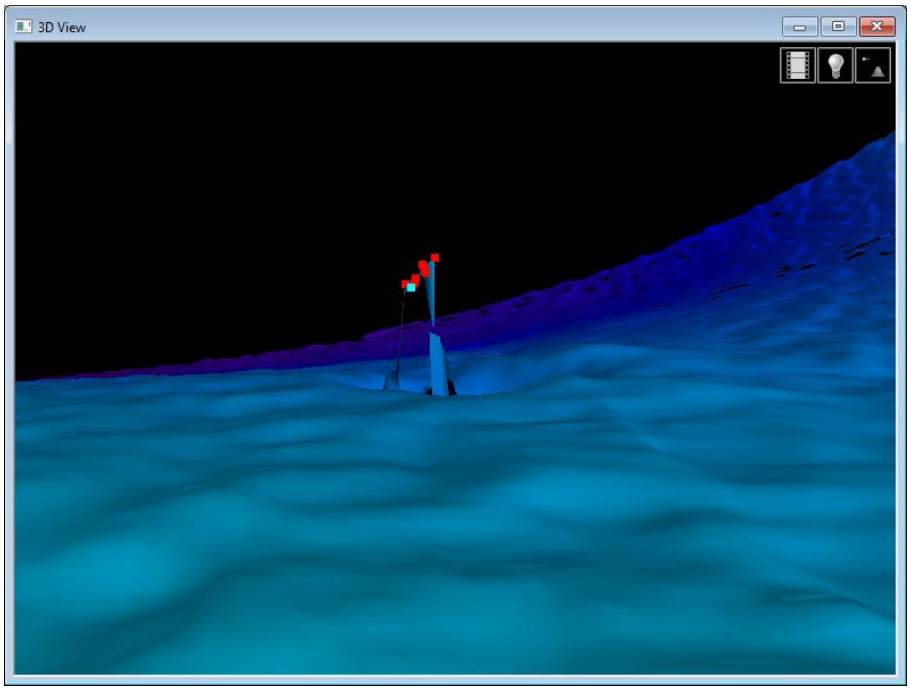
Subset Editor can be opened from within the 3D Display window to perform edits to the data.



d. In the **Layers** window, highlight the **CUBE_1m** layer and on the **Properties** window, under **Colour > Drape** select **18474_1:Band1** from the drop list.

e. Disable the draping chart, just selecting **(None)** under **Colour > Drape** drop list

Since CARIS HIPS and SIPS 10.2 release, you can select nodal data in 3D mode.



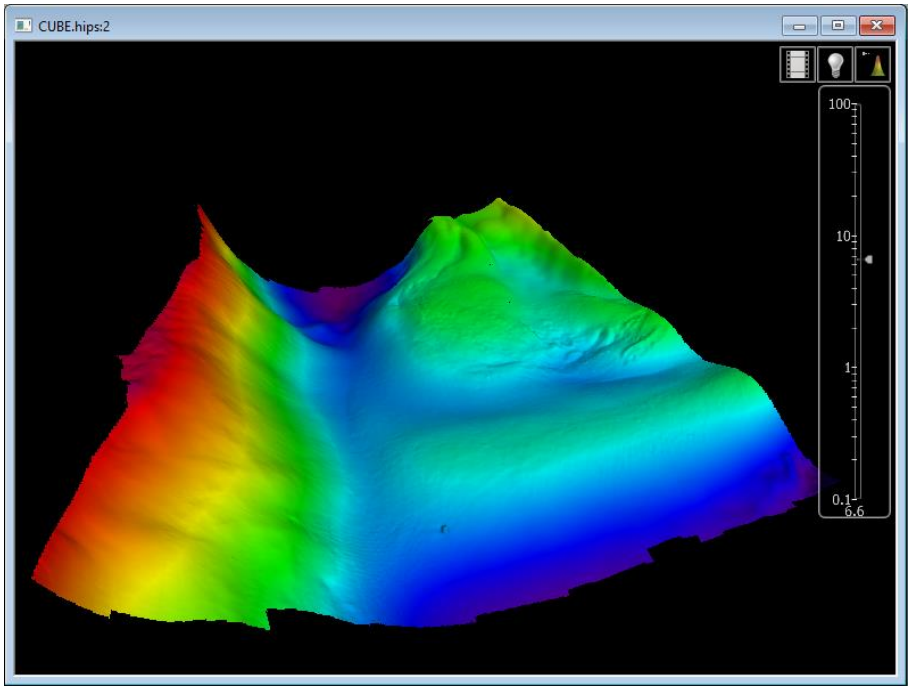
f. Highlight the **CUBE_1m** layer within the **Layers – Organize layers** window and select the top Shoal nodes.

Selection

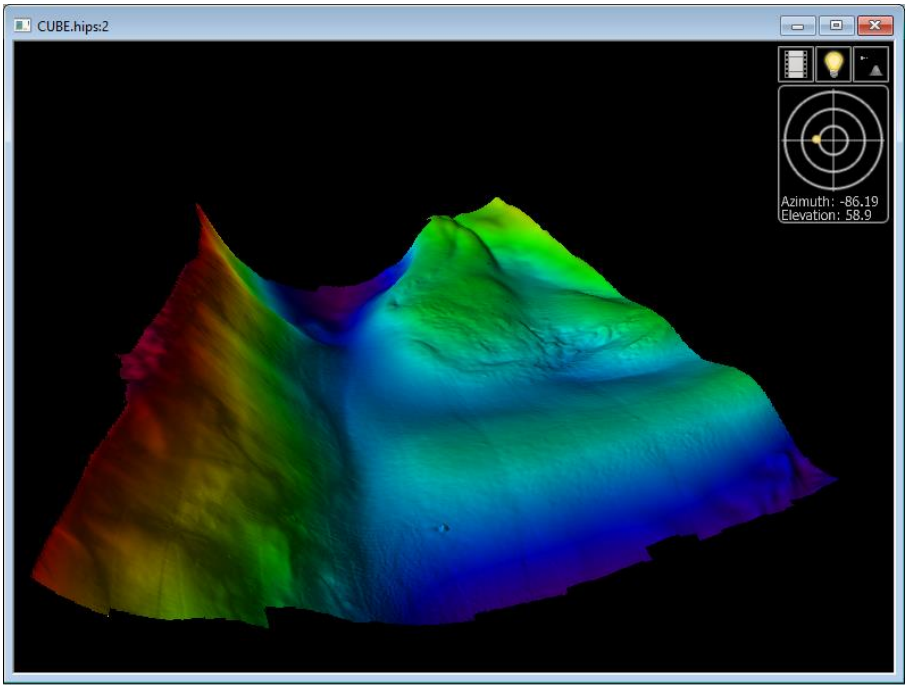
Longitude	Latitude	Deep (m)	Density	Depth (m)	Hypothesis_Count	Hypothesis_Str...	Mean (m)	Node_St...	Shoal (m)	Std_Dev (...	Uncertai...	User_No...	Dataset Name
122.58828...	47.58494...	46.8	2	46.8	1	0.000	46.8	0.0	46.8	0.0	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58829...	47.58495...	46.5	3	46.4	1	0.000	46.4	0.1	46.4	0.1	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58828...	47.58495...	46.8	6	46.7	1	0.000	46.7	0.1	46.6	0.1	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58830...	47.58496...	47.4	5	46.3	2	1.000	46.3	0.5	46.2	0.1	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58829...	47.58496...	46.6	7	46.4	1	0.000	46.4	0.2	46.2	0.2	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58828...	47.58496...	46.8	9	46.6	1	0.000	46.6	0.1	46.5	0.1	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58829...	47.58496...	46.5	2	46.4	1	0.000	46.4	0.0	46.4	0.0	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58827...	47.58496...	46.6	4	46.5	1	0.000	46.5	0.1	46.4	0.1	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar
122.58826...	47.58496...	46.6	2	46.5	1	0.000	46.5	0.0	46.5	0.0	0.3	N/A	\Training\HIPS\Surface\CUBE_1m.csar

Output Selection

The Nodal information will be displayed in the **Selection** window.



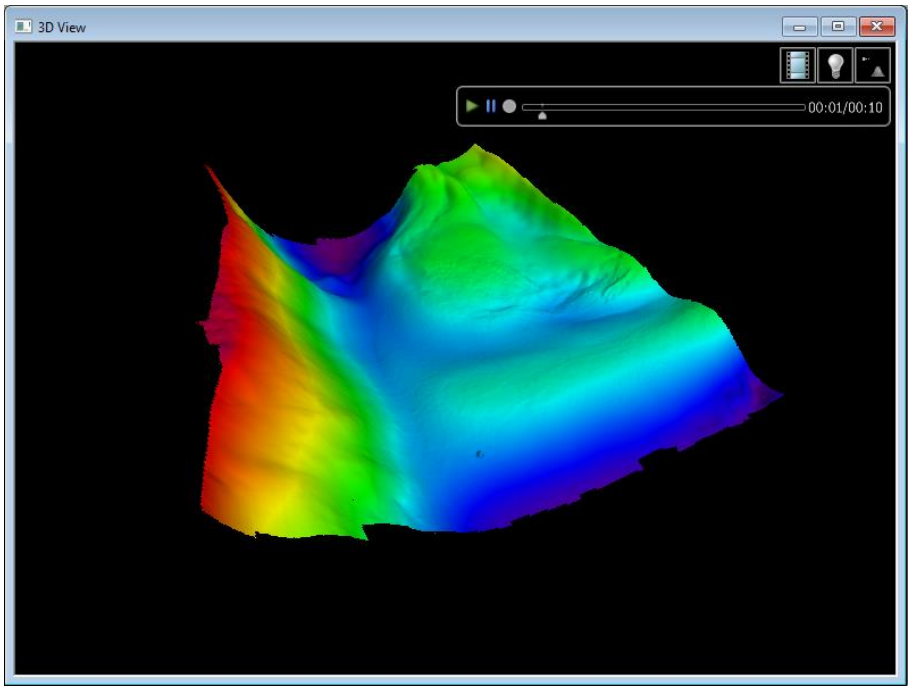
g. In the **3D View** Window, (top right corner) is located the **Vertical Exaggeration** icon. Once you click on the icon, a vertical slide appears, allowing you to change the **Vertical Exaggeration** on the fly. Default value is **1**.



h. In the **3D View** Window, (top middle icon) is located the **Sun Illumination** icon. Once you click on the icon, a Circle with a point indicates the Azimuth and Elevation of the Source of light illuminating the Surface, grabbing and releasing the point around the circle (with left button of mouse), the 3D presentation changes with the latest parameters.

Record a Video

Video recordings can be produced for external review and demonstrations.



Exercise 62.

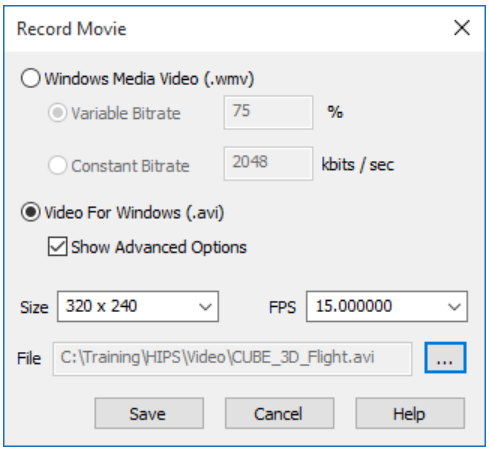
a. Enhance the surface by using the Vertical Exaggeration and Shading options.

b. Click the **Start/Stop Recording** icon on the 3D View toolbar to enable video recording and continue to navigate through the 3D scene.

c. Click the **Start/Stop Recording** icon again to disable the recording. Click the **Playback** and **Pause/Resume playback** functions on the 3D View toolbar to view the recording.

d. If satisfied with the recording, select the menu **Tools > 3D Flight Path > Export to Video**. This opens the Record Movie dialog box.

Optionally, you can also store the flight path to a XML file on the menu **Tools > 3D Flight path > Save to file**. This file can be opened and played back in 3D View.



e. You can save the recording to *.wmv or *.avi. Select **.avi** and give the video the name of **CUBE_3D_Flight** on the **…\Video** folder. Click **Save** and **OK** to generate the video.

f. Click the **3D Display** window icon to close the 3D scene.

g. Maximize the main 2D Display Window.

Additional Data Processing

The following section outlines some additional tools that can be used to streamline a processing workflow and prepare your fully processed dataset for final product creation.

Process Designer

Process Designer automates what could otherwise be labour-intensive or time-consuming processing by combining a number of tasks into a single process model file that can re-opened and used on multiple track lines or even multiple projects. The Process Designer is a separate application that is launched from the HIPS interface.

The workflow for Process Designer is:

- Select the processes to run,
- Enter appropriate values and settings and connect them.
- Use the Run Process Designer Model, to apply the processes to your data.

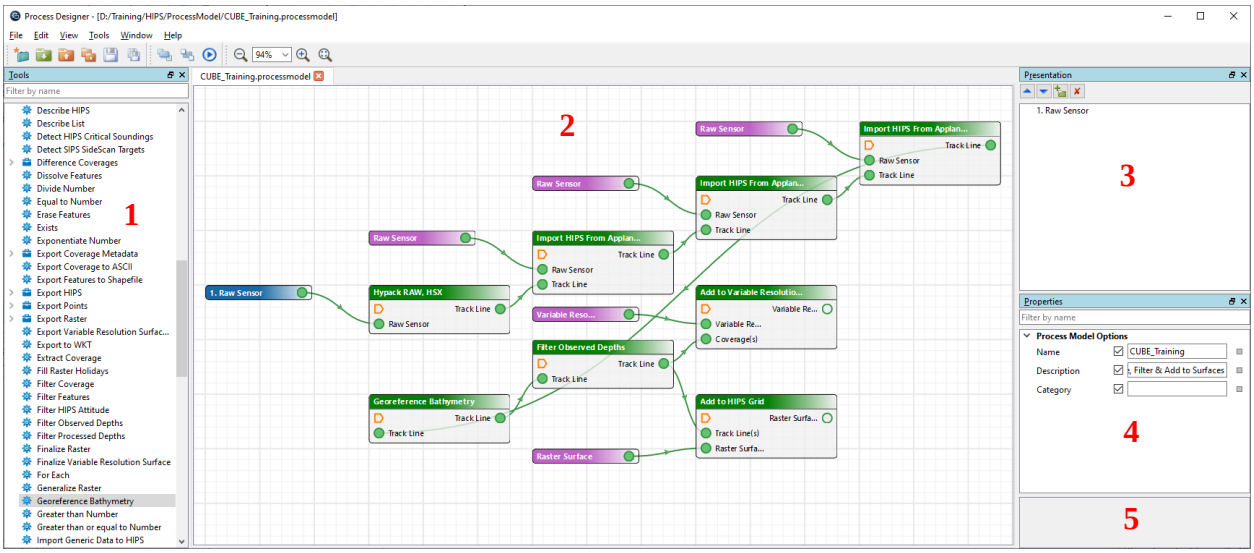
You will be creating a group of Processes in Process Designer, which will import and process more data from the same survey area acquired by a second NOAA vessel (Fairweather Hydro Survey Launch, #2805). This will also require us to use another existing HVF.

In addition, you will add the newly created and processed lines to the existing CUBE and variable resolution surfaces. However, when they are open in HIPS they are locked for editing, so you will need to close them before running the model.

Exercise 63.

a. Highlight the **CUBE_1m** surface on **Project** window. Right-click and click **Close Source** from the drop list. Repeat the process and close **Seattle_VR** surface as well.

b. Select **Tools > Editors > Process Designer…** from the main menu.



Process Designer consists of the **Design** window (**1**) in which the processes can be organized. The **Tools** window (**2**) lists all the processes available. The **Presentation** window (**3**) describe the order to execute **New parameters**. The **Properties** window (**4**) displays all the options for the process selected in the **Design** window and if none is selected, the **name description** and **category** of the current Process model. When a **Properties** field is selected, a **Description** (**5**) of the option is displayed in the bottom of the **Properties** window.

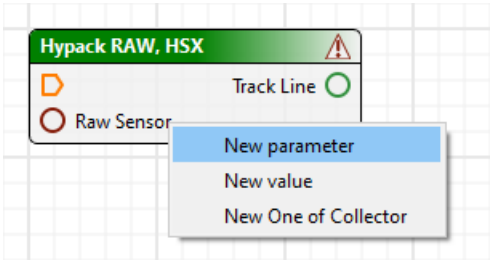
Add Processes

The processes step by step on the Mutlibeam Processing Workflow, must be added. The first step in Process Designer will be **Import To HIPS**, which will import the raw sonar files into the existing HIPS project

Exercise 64.

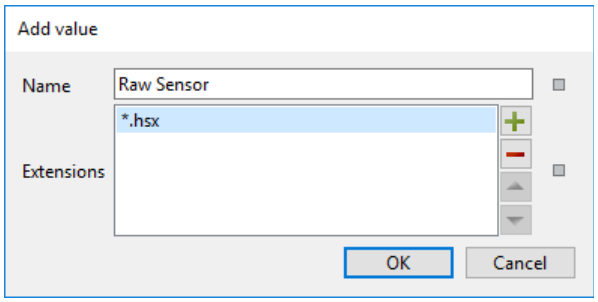
a. Add the **Import to HIPS > Hypack RAW, HSX** process to the design window.

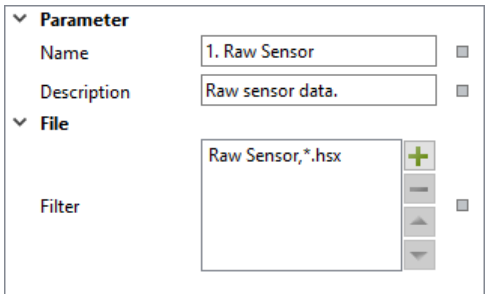
The **New parameter**, allows to ask for a new file every time, so it will create a "**Generic**" model asking for different files running same processes every time. **New value** allows to set up for an specific file when the Model will be run. And **New One of Collector**, takes many possible inputs and pass them forward as a single input to a future process. This can be used, for example, in complicated models with early branches to combine back into a single stream for later processing.



b. Right-click the **Hypack RAW,HSX > Sensor** and click **New Parameter** On the pop-up window.

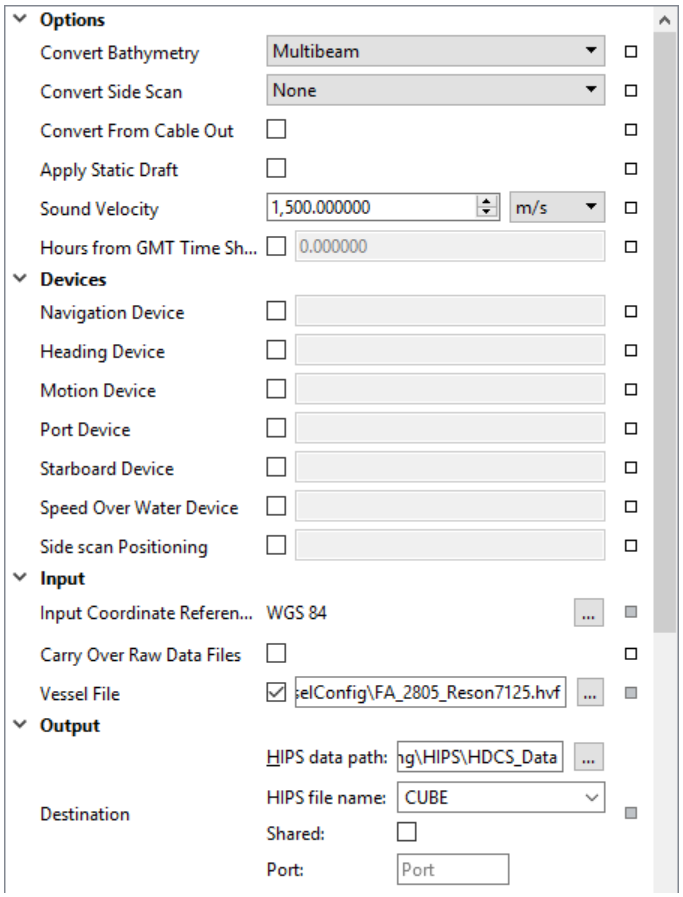
There will be a new process called Raw Sensor. It will allow us to define the location, and the extensions the software will look at the time of running the Process Designer.





c. Select the **Raw Sensor** process and select on **Filter** the **+** icon, then type on **Name Raw Sensor** and on **+** icon type ***.hsx**.

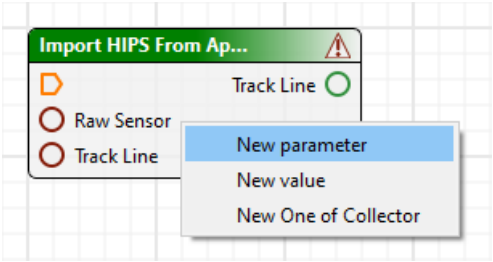
d. Under **Parameter** type **1. Raw Sensor** under **Name** and leave **Raw Sensor data** on **Description**. Click **OK**.



e. Select the **Hypack RAW, HSX** process and within **Properties** window, define:
   - **Convert Bathymetry > Multibeam**
   - **Vessel File: VesselConfig/FA_2805_Reson7125**
   - **HIPS data path > browse … to the HDCS_Data folder**
   - **Project Name > CUBE**

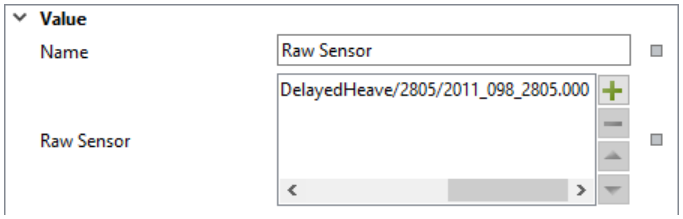
Note: The Shared and Port options are useful just in CARIS Onboard, where you will share the lines and surfaces on an external viewer. In HIPS and SIPS these options are ignored.

f. Add the **Import HIPS from Auxiliary > Import HIPS from Applanix POS MV** process to the design window.

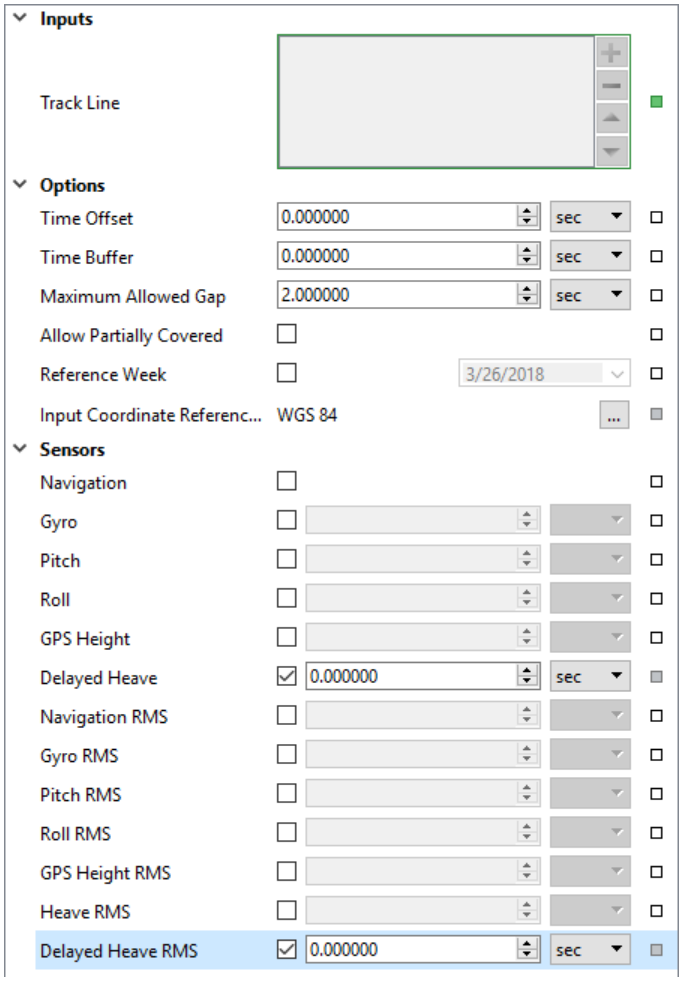


g. Right-click the **Import HIPS from Applanix POS MV > Raw Sensor** and click **New Value…**

Note that the new **Raw Sensor Value** (in purple) has an exclamation mark, since is asking for a specific file, it will disappear when the file is fulfilled.

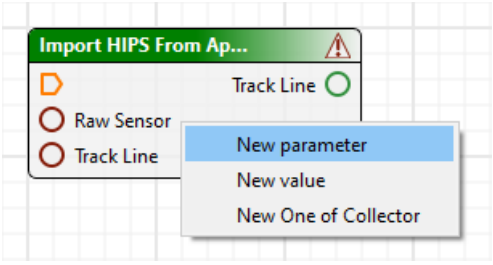


h. Select the **Raw Sensor** process and select on **Raw Sensor** the **+** icon, then browse for the file **2011_098_2805.000** located on the folder **…\PreProcess\CUBE\Applanix\DelayedHeave\2805**

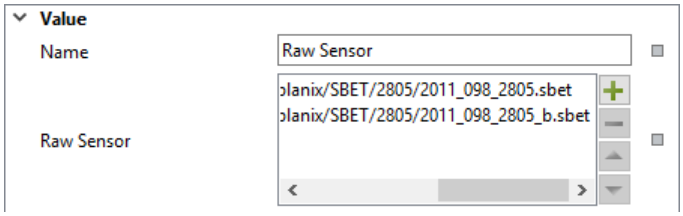


i. Select the **Import HIPS from Applanix POS MV** process and within **Properties** window, define:
   - Enable the **Delayed Heave** option and type **0**, make sure the units selected are **sec** (seconds) from the drop list**.**
   - Enable the **Delayed Heave RMS** option and type **0**, make sure the units selected are **sec** (seconds) from the drop list**.**

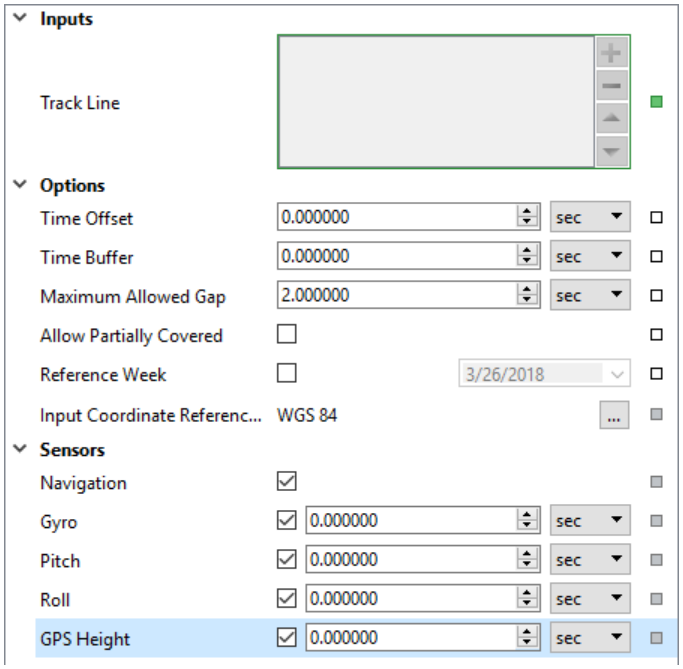
j. Add the **Import HIPS from Auxiliary > Import HIPS from Applanix SBET** process to the design window.



k. Right-click the **Import HIPS from Applanix SBET > Raw Sensor** and click **New Value…**

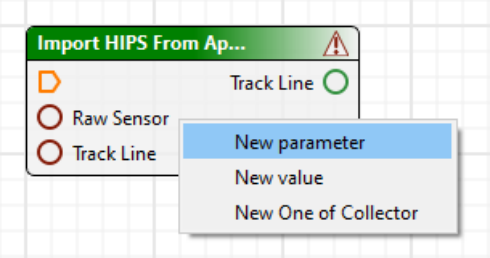


l. Select the **Raw Sensor** process and select on **Raw Sensor** the **+** icon, then browse for the files **2011_098_2805.sbet** and **2011_098_2805_b.sbet** located on the folder **…\PreProcess\CUBE\Applanix\SBET\2805**

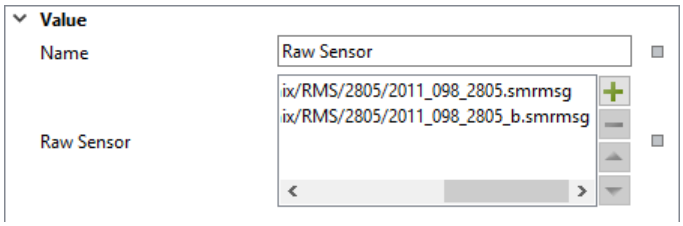


m. Select the **Import HIPS from Applanix SBET** process and within **Properties** window, define:
- Turn on **Navigation** option.
- Turn on **Gyro** option and type **0.0**
- Turn on **Pitch** option and type **0.0**
- Turn on **Roll** option and type **0.0**
- Turn on **GPS Height** option and type **0.0**
- Make sure the units selected are **sec** (seconds) from the drop list.

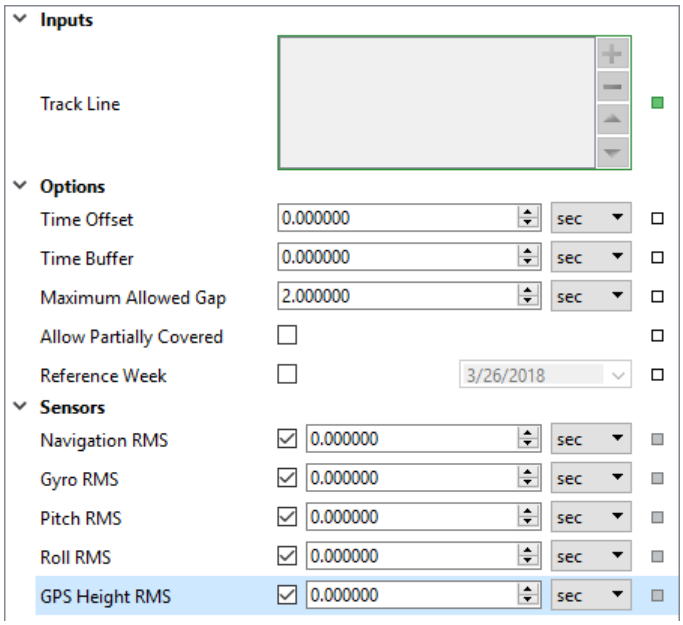
n. Add the **Import HIPS from Auxiliary > Import HIPS from Applanix RMS** process to the design window.



o. Right-click the **Import HIPS from Applanix RMS > Raw Sensor** and click **New Value…**

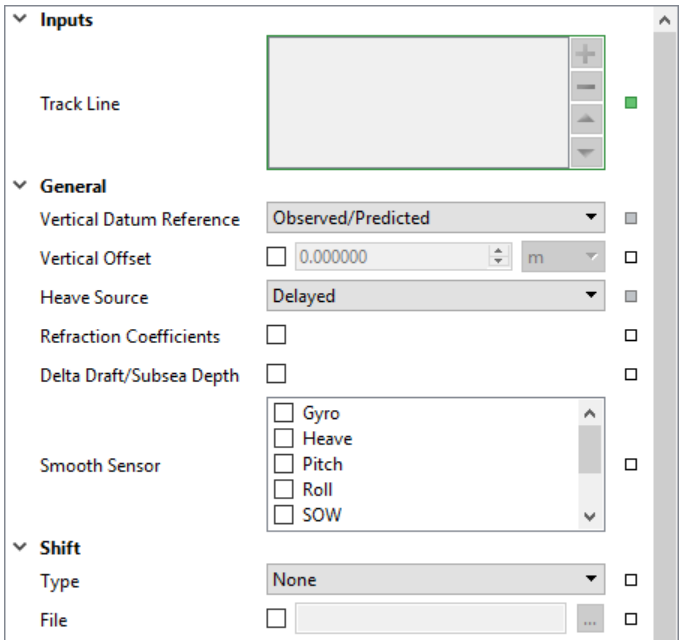


p. Select the **Raw Sensor** process and select on **Raw Sensor** the **+** icon, then browse for the files **2011_098_2805.smrmsg** and **2011_098_2805_b.smrmsg** located on the folder **…\PreProcess\CUBE\Applanix\RMS\2805**



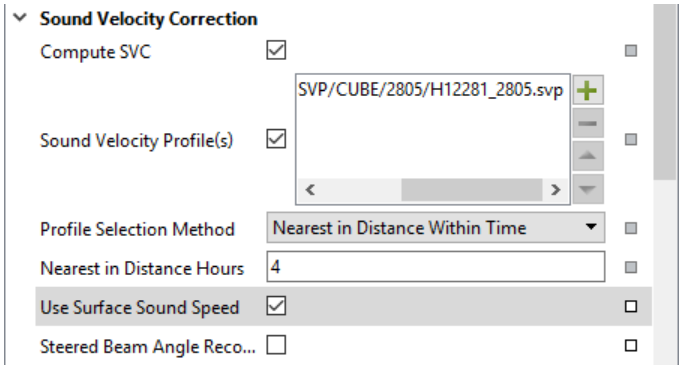
q. Select the **Import HIPS from Applanix RMS** process and within **Properties** window, define:
   - Turn on **Navigation RMS** option and type **0**
   - Turn on **Gyro RMS** option and type **0**
   - Turn on **Pitch RMS** option and type **0**
   - Turn on **Roll RMS** option and type **0**
   - Turn on **GPS Height RMS** option and type **0**
   - Make sure the units selected are **sec** (seconds) from the drop list.

r. Add the **Georeference Bathymetry** process to the design window.

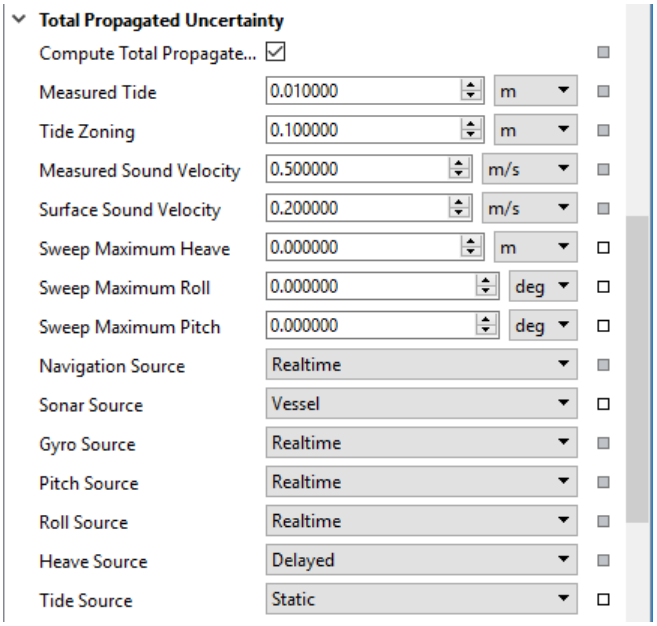


s. In **Properties** window, under **General** define:
   - **Vertical Datum Reference: Observed/Predicted.**
   - **Heave Source: Delayed.**

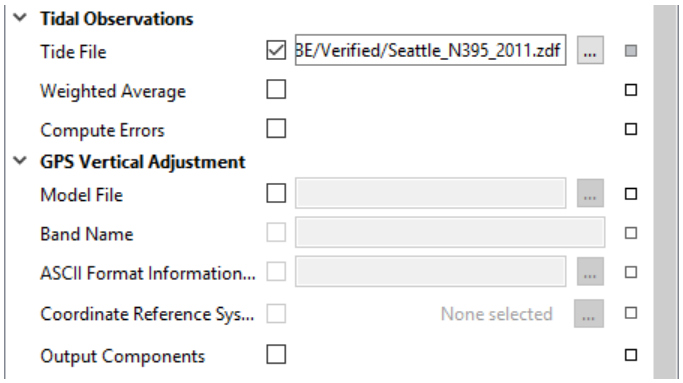
t. Leave all other options in **General** and **Shift** disabled by default.



u. Enable **Compute SVC** option, under **Sound Velocity Correction**
   - Enable **Sound Velocity Profile(s)** option, and click on the**+** icon, browse the file **…\SVP\CUBE|2805\H12281_2805.svp**.
   - **Profile Selection Method: Nearest in distance within time.**
   - On **Nearest in distance Hours**, type **4**
   - Enable **Use Surface Sound Speed** checkbox



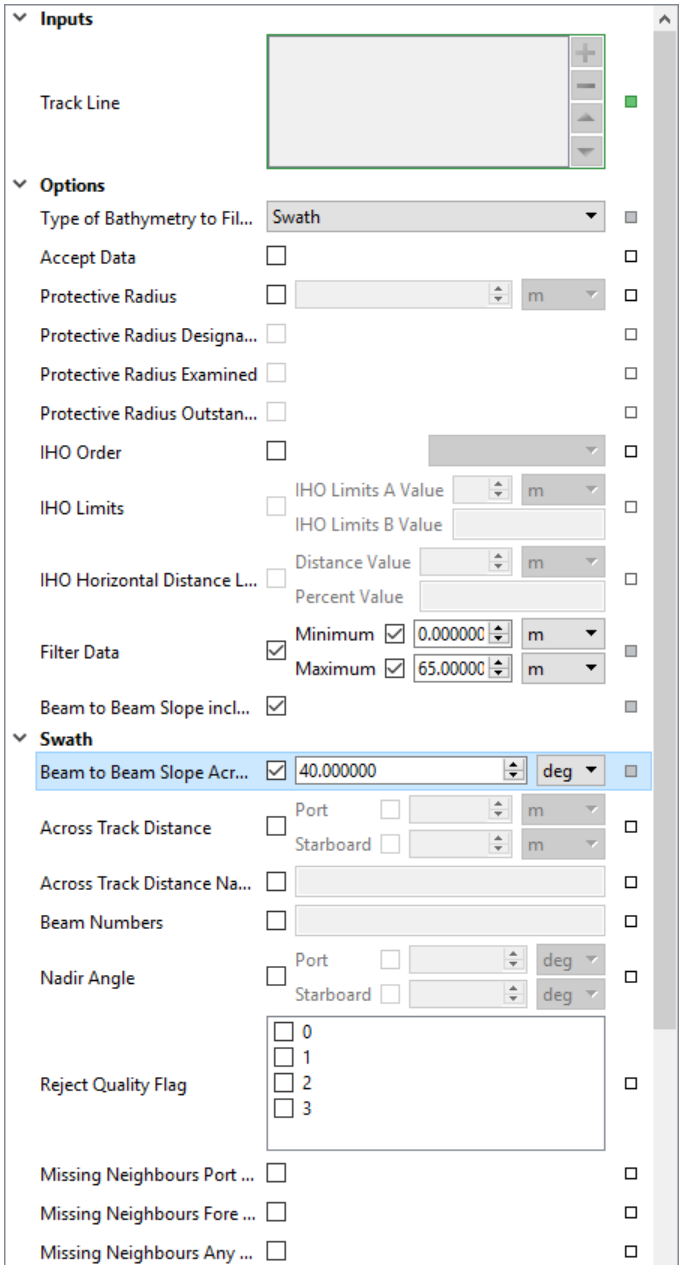
v. Enable **Compute Total Propagated Uncertainty** option, under **Total Propagated Uncertainty** and define:
   - **Measured Tide = 0.01 m**
   - **Tide Zoning = 0.1 m**
   - **Measured Sound Velocity = 0.5 m/s**
   - **Surface Sound Velocity= 0.2 m/s**
   - **Navigation Source > Realtime**
   - **Sonar Source > Vessel**
   - **Gyro Source > Realtime**
   - **Pitch Source > Realtime**
   - **Roll Source > Realtime**
   - **Heave Source > Delayed**
   - **Tide Source > Static**



w. Enable **Tide File** option, under **Tidal Observations** and define:
   - On **Tide File** browse **…** for the file **…\Tide\CUBE\Verified\Seattle_N395_2011.zdf**

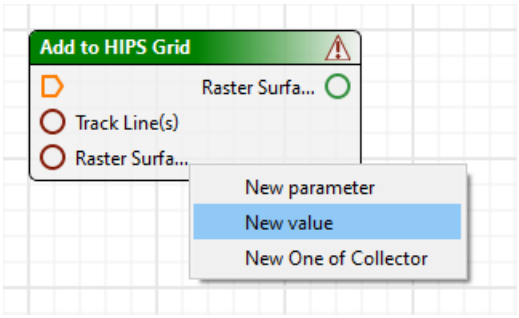
x. Leave the **GPS Vertical Adjustment** section disabled by default.

y. Add the **Filter Observed Depths** process to the design window.



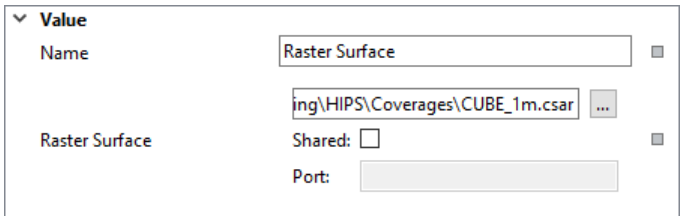
z. Highlight the **Filter Observed Depths** and on **Properties** window, define:
   - **Type of Bathymetry to Filter > Swath**
   - **Filter Data > Minimum 0 m > Maximum 65 m**
   - Enable **Beam to Beam Slope include rejected** checkbox.
   - Enable **Beam to Beam Slope Across Track Angle** and type **40**.

aa. Add the **Add to HIPS Grid** process to the design window.



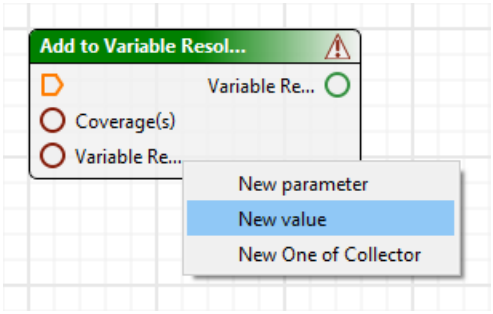
bb. Right-click the **Add to HIPS Grid > Raster Surface…** and click **New value**

Now you can select the original location of the surface to which the process designer will add lines to.

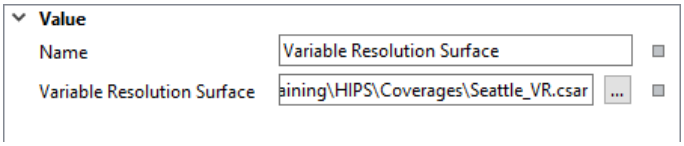


cc. On **Raster Surface** define the location (**…**) as **…\Coverages\CUBE_1m.csar**

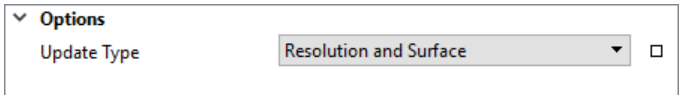
dd. Add the **Add to Variable Resolution Surface** process to the design window.



ee. Right-click the **Add to Variable Resolution Surface > Variable Resolution Surface** and click **New value**



ff. Select the **Variable Resolution Surface** and browse for the file **…\Coverages\Seattle_VR.csar**

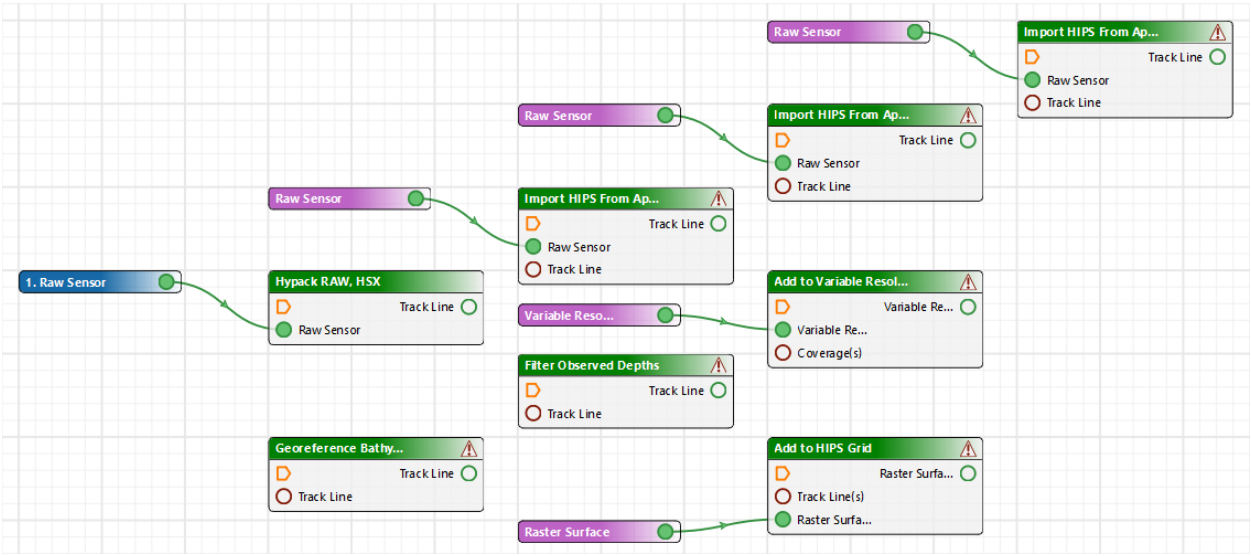


gg. Highlight the **Add to Variable Resolution Surface** and on **Properties** Window, leave **Update Type** as **Resolution and Surface**.

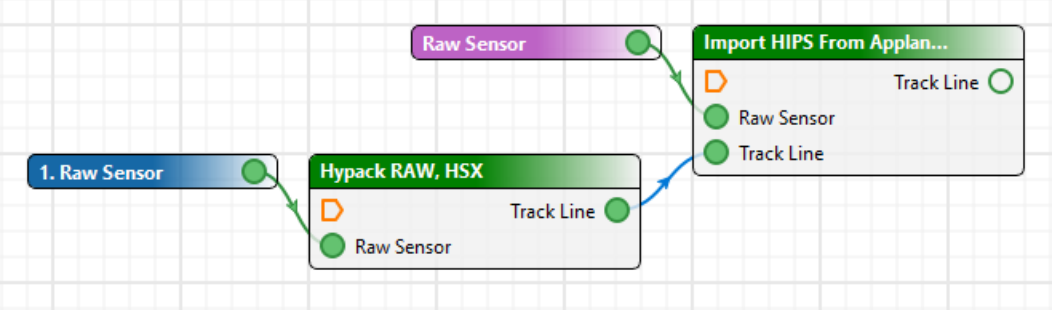
Joining Processes

The next step consists in organizing all processes and making connections on all of them, telling the Process Designer what will be the order to run.

You;ll see that most of the processes (Green Boxes) have an Exclamation mark, indicating that haven't been connected (joined) to any other processes establishing the chronological order to run each one.



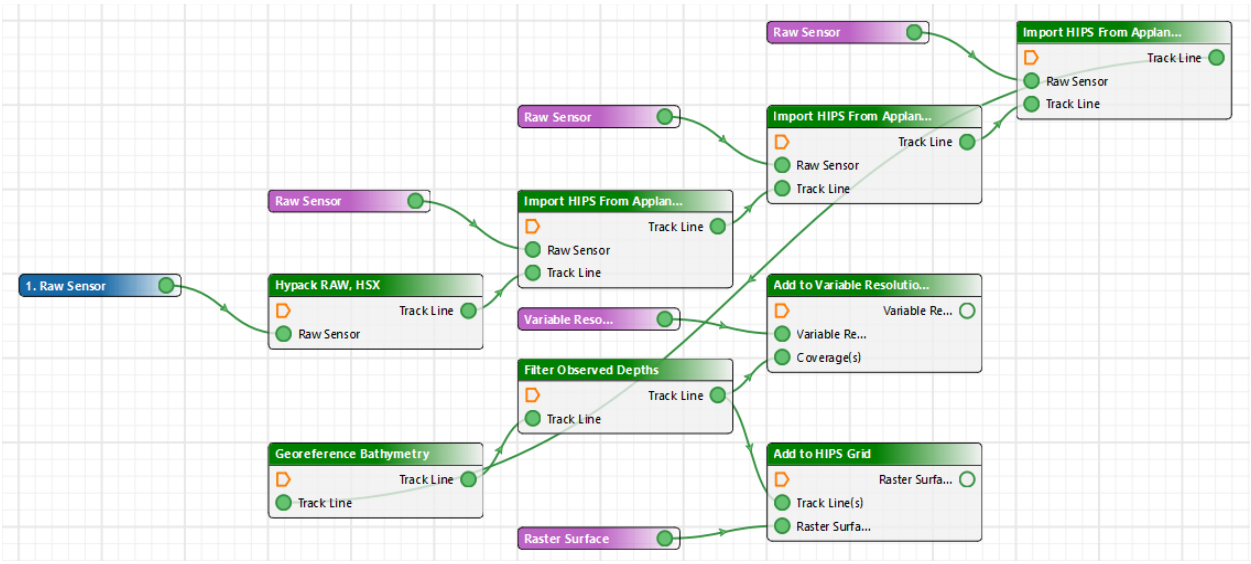
Clicking on the output Track Line, holding the mouse button and drop it on the input Track Line, of the next process.



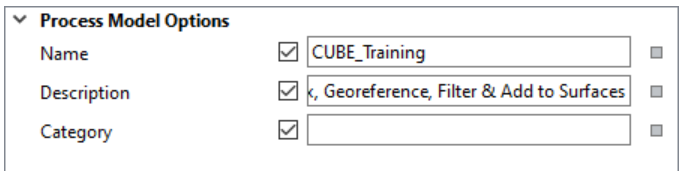
Exercise 65.

a. Connect the initial **Raw Sensor output** with **Raw Sensor** Input on **Hypack RAW, HSX**. Repeat for all other processes with **Raw Sensor** as an Input.

b. Connect each process starting with **Track line** to **Track line(s)**, Except **Add to Variable Resolution Surface** where the input would be **Coverage(s)** coming from the same output **Track Line** of **Filter Observed Depths**



Finally the model should be named and described on Properties Window



c. Click outside of any process on Process Designer, and then on **Properties** Window, **Name** as **CUBE_Training** and on **Description** fill with **Import, Applanix, Georeference, Filter & Add to Surfaces**. Leave **Category** empty.

Once the model is complete, the Process Designer file has to be saved.

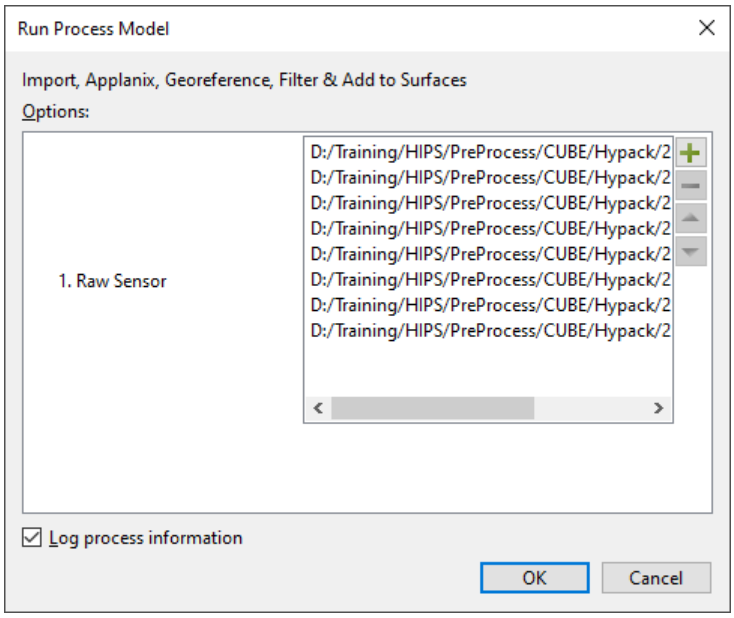
d. Select **File > Save** and name it **CUBE_Training_Excercise** in to **…\ProcessModel** folder. Exit Process Designer with **File > Exit**.

Run the Process Model

At this point, you have finished to create, configure and joined all processes, now is time to run the processmodel you have created.

Exercise 66.

a. Execute the Process Model by selecting **Tools > Run Process Designer Model...** It will ask for the file to run. Browse for **CUBE_Training.processmodel** in **…\ProcessModel** Folder. Click **Open**.



The **Run CUBE_Training** window will appear, asking for the input files (Raw Sensor) to: Import Hypack data.

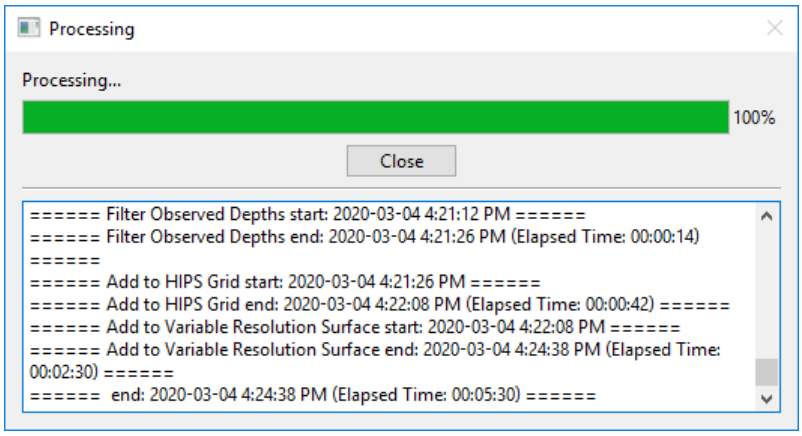
b. Click the **+** symbol of **1. Raw Sensor** and browse for **…\PreProcess\CUBE\Hypack\FA_2805_Reson7125\2011-098** folder and select all the **HSX** files there. Click **Open**.

When running a process model in the application, a check box is available to **Log process information** to the Logs folder of the application when the process completes. This stores additional information, such as the parameters specified for the process, the inputs and the time the process took to complete.

c. Enable the **Log process information** checkbox**.**

d. Click **OK**.

The Process Designer model is now running and will show the results in on a separate output window.

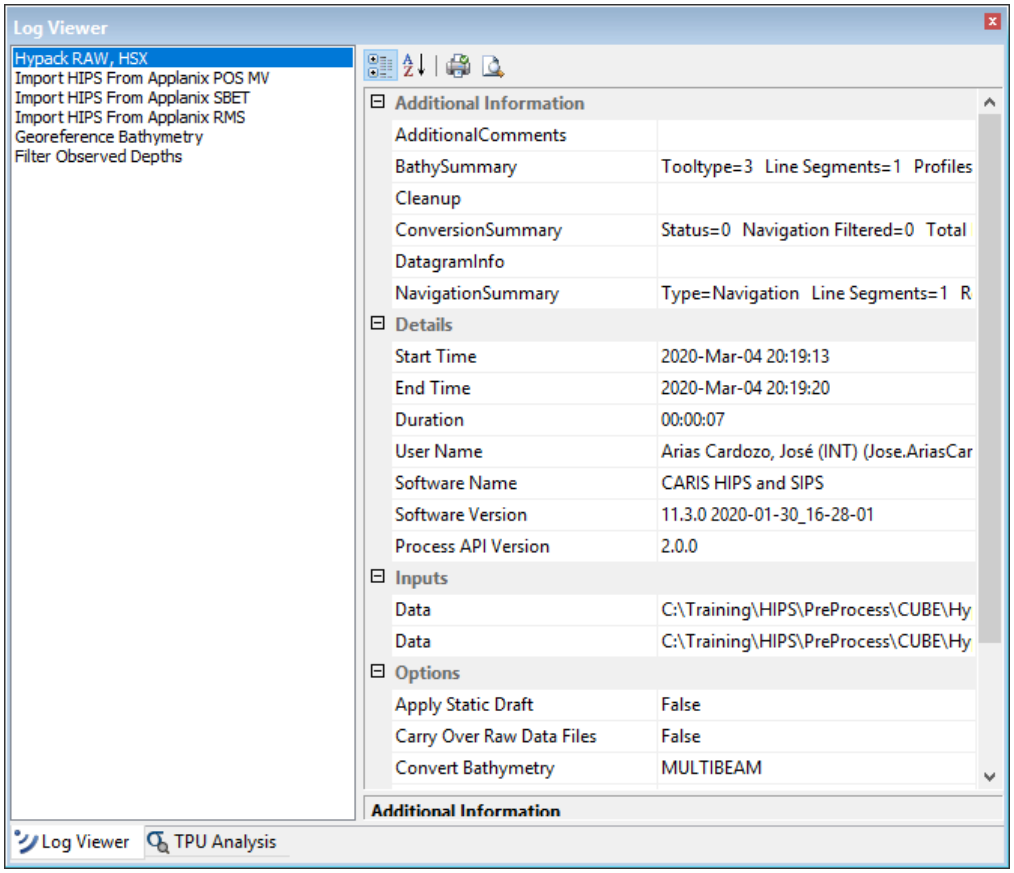


e. Click on **Close**.

After Process Designer is finished, you will see the imported lines in HIPS.

Exercise 67.

a. On **Active Track Lines** window, expand the layer **CUBE > Track Lines > Vessel = 'FA_2805_Reson7125' > Day = '2011-098'**and select one of the lines.



The processes for each one can be viewed in the Log Viewer.

The final step is to reload surfaces with the updated coverage.

b. Click the **Open** icon or select the **File > Open > File…** option from the main menu.

c. In **…\Coverages** folder select **CUBE_1m** and **Seattle_VR** surfaces. (The <Ctrl> Key allows you to select more than one file).

Note that both surfaces have been updated to include the new project lines, recently added by Process Designer.

Bathymetric Products

Bathymetric products could be the finalized surface itself, or other products that can be created from the data to be used for further analysis. In the next few exercises, you will examine some of the post-processing options for creating some of these products.

Finalize Surface

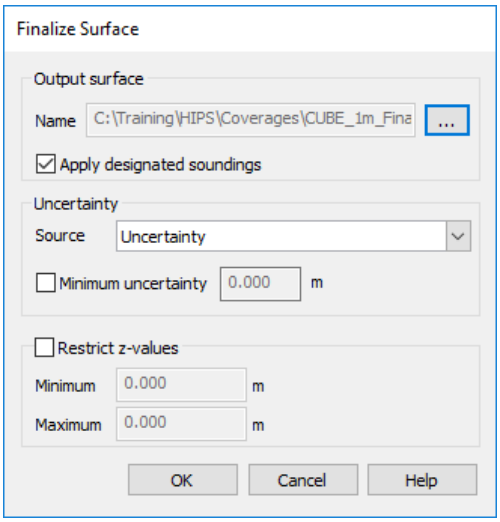
In order to maintain the designated soundings and have them carried through to products such as selected soundings, you must finalize the surface.

Exercise 68.

a. Highlight the layer **CUBE_1m** in the **Layers** window.

b. Select the option **Tools > Coverages > Modify > Finalize…**

This will open the **Finalize Surface** dialog box.



c. On the **Name** field click the Browse option (**…**) Navigate to the **…\Covrages** folder and name the surface **CUBE_1m_Final.csar**.

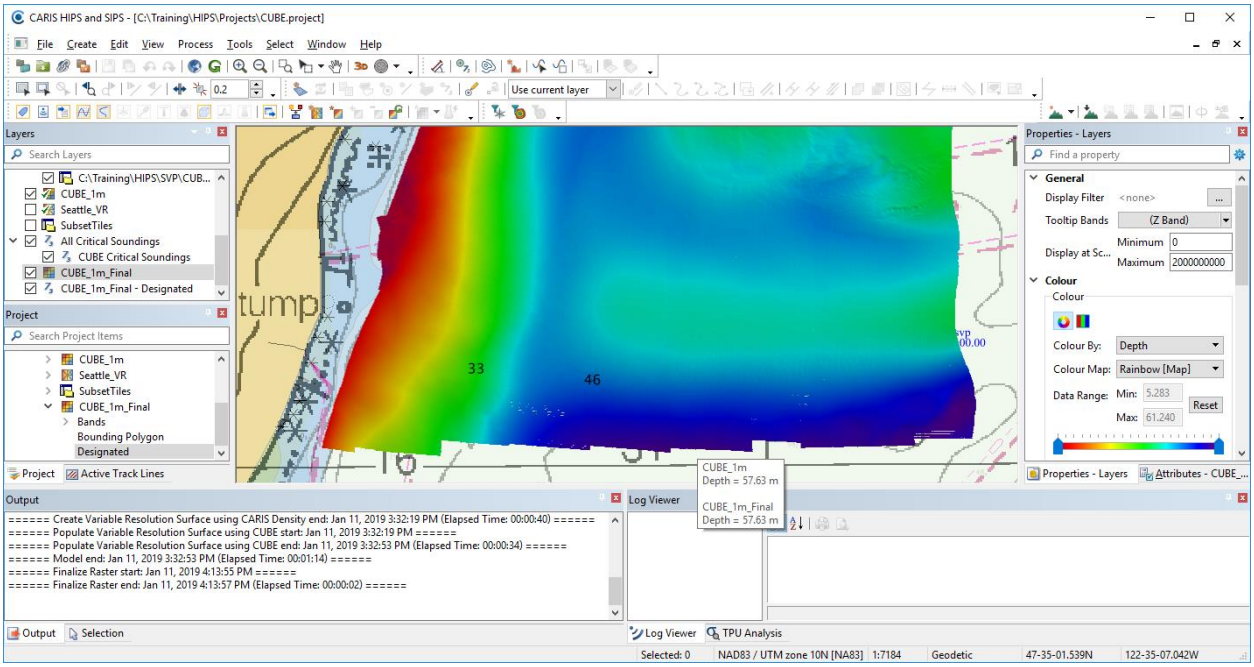
d. Enable **Apply designated soundings** option.

e. Click **Uncertainty** as the **Source** of **Uncertainty**.

f. Leave the **Restrict z-values** option disabled and click **OK**.

The **Restrict z-values** values allow the finalized surface to contain only a specified range of depth nodes. This allows the finalized surface to be "clipped" so that the surface will only contain depths where the surface resolution is optimal.

The **Finalize** process will add the Designated Sounding value to the surface, as an additional layer (**Designated**).



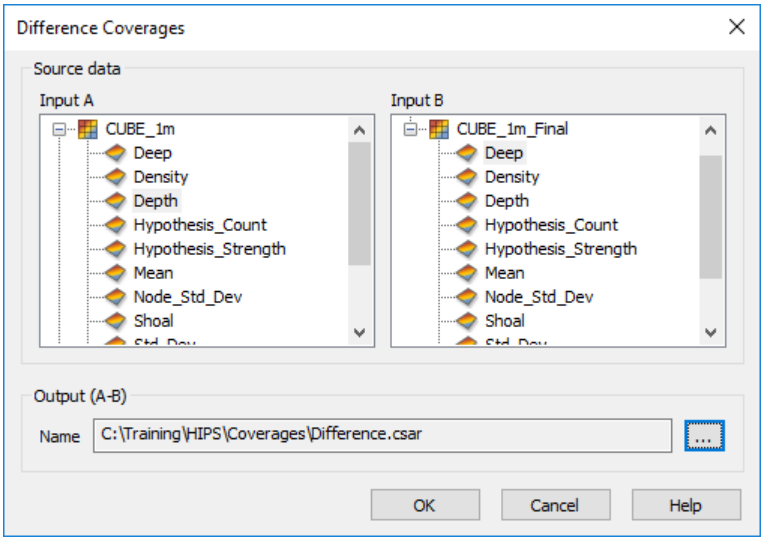
g. Unfold the **CUBE_1m_Final** object within the **Project** window. On the **Designated** band, make right click and select **Add Layer** from the pop up menu

As an optional step, a variable resolution surface can be finalized as well, including **Designated** (soundings) layer.

h. Save the project by selecting **File > Save > Save Project…**

Surface Difference

For quick comparisons of historical to new data, or cleaned to uncleaned data, the Surface Difference function is a valuable QC tool. It is a simple mathematical operation, where the Difference Surface is the result of Surface 1 minus Surface 2.

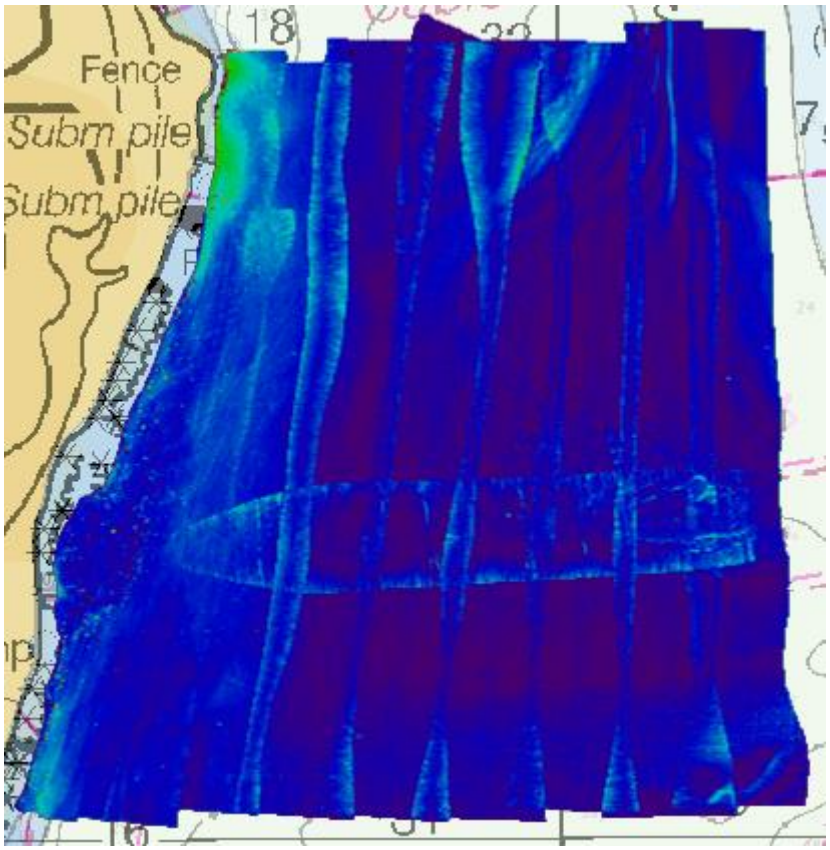


Exercise 69.

a. Select the **Tools > Coverages > Modify > Difference…** option from the main menu.

b. For Surface 1 select the **Depth** layer in **CUBE_1m** and for Surface 2 select the **Deep** layer in **CUBE_1m_Final**.

c. Click the Browse option (**…**), navigate to the **…\Coverges** folder and name the surface **Difference.csar**.



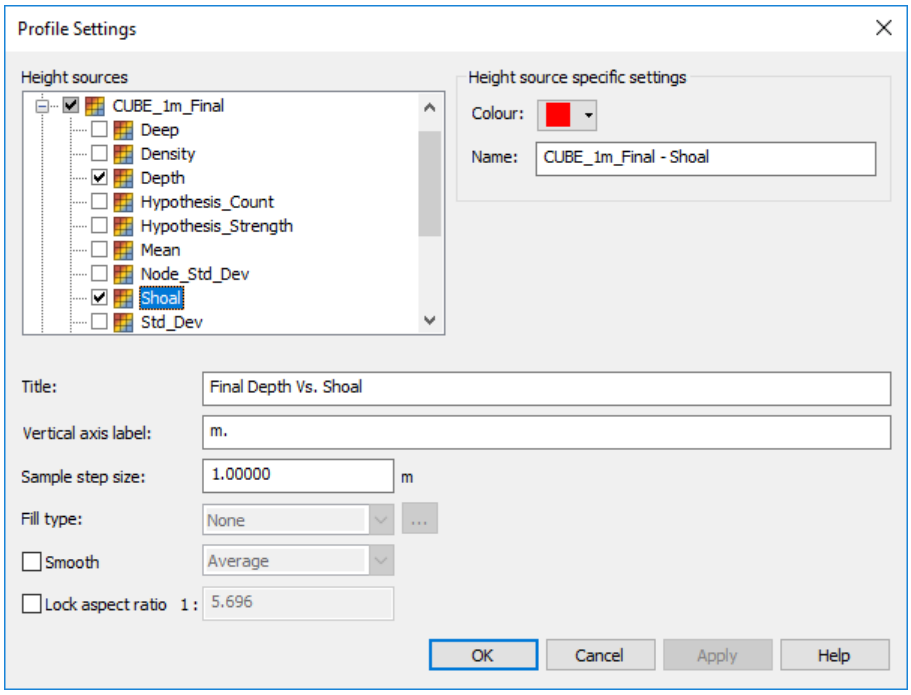
The new surface will appear in the layer list and will show areas where potential areas could be investigated.

d. Disable the **Difference** layer on **Layers** window.

e. Save the project by selecting **File > Save > Save Project…**

Surface Profile Display

HIPS can generate a **2-Dimensional vertical profile** of a Surface or another specified height source. The profile can be generated for many reasons, for example, to measure seabed gradients or check motion artifacts.



Exercise 70.

a. Select the **Tools > Profile > By Digitizing…** option from the main menu or select the **Digitize Profile** icon.

b. In the **Profile Settings** window dialog, under **Height Sources**, enable the **Depth** layer of the **CUBE_1m_Final** surface. Under **Height Source specific settings** assign the **Colour Green**.

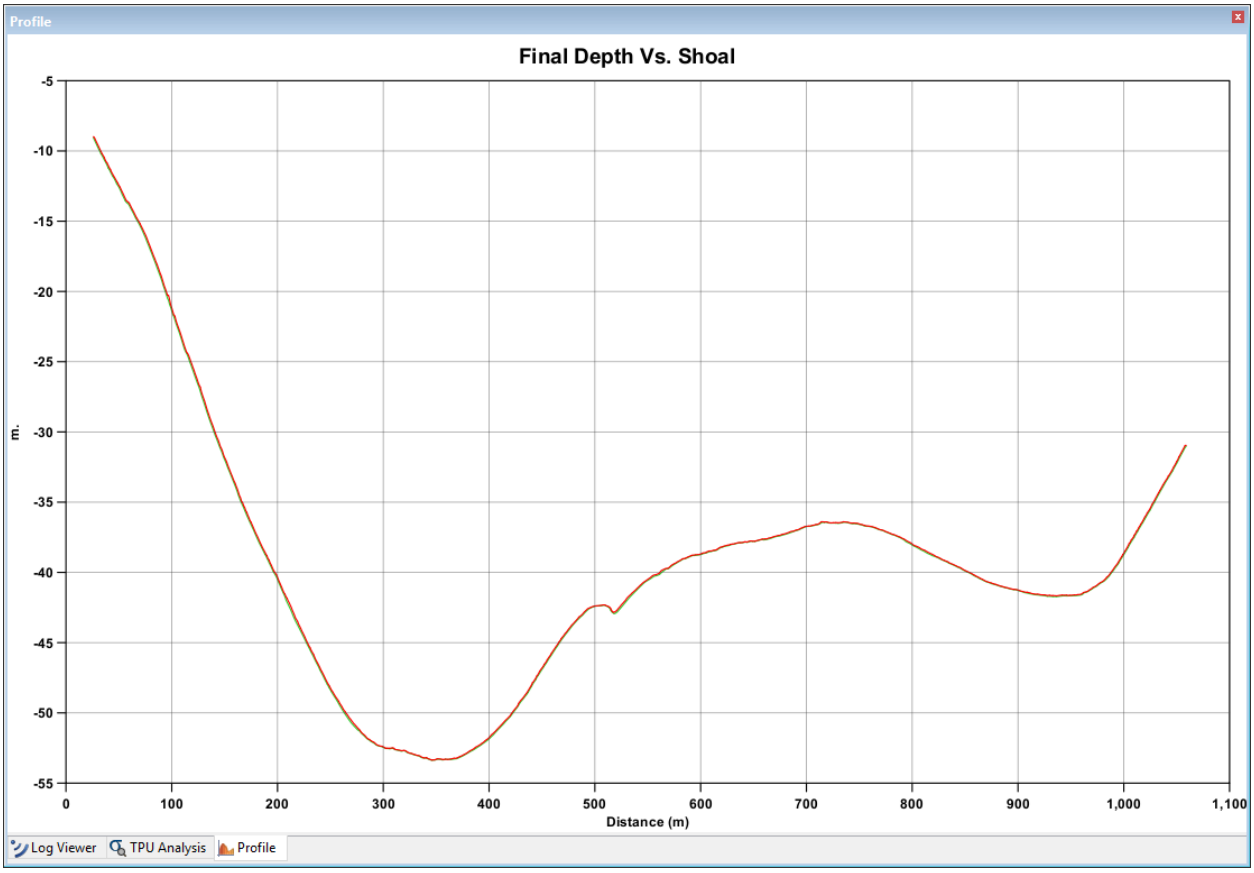
c. In the **Profile Settings** window dialog, under **Height Sources**, enable the **Shoal** layer of the **CUBE_1m_Final** surface. Under **Height Sources specific settings**, assign the **Colour Red**.

d. Enter the Title **Final Depth Vs. Shoal** for the profile.

e. Enter a Vertical axis label **m** and Sample step size of **1.0**. Click **OK**.

f. In the Display Window click once to select the anchor position of the profile. Click a second point across the surface where you want to see a profile. To finish, right-click and choose **Edit Line> End line** or press the <**End**> key.

The profile appears in the Profile Window. As well as two point profiles, multi-point profiles can also be generated. Any height source open in HIPS can be added to the profile display. Multiple profile lines can be displayed on a Profile layer.



The Profile Settings dialog box can be recalled by right-clicking in the Profile Window and selecting **Setting** from the pop up window.

g. Right-click in the Profile Window to export the profile to a variety of image formats, or as ASCII text.

The Profiles sub-layer within the Layers Window can be selected and removed.

h. Select a profile and go to **Edit > Delete > Superselection** to delete an existing Profile. Click **Yes** on the pop up window.

Profiles that have been created are placed on a temporary **Profiles** layer in the Layers window and can be selected from there. Once the software is closed, the profiles will be lost.

Cross Profiles

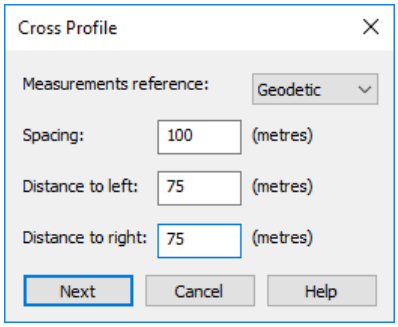
You will now look at how profile at a user define spacing can be generated along of line of interest (ie. the middle of a waterway, a canal, etc.).

Exercise 71.

a. Open the **Recommended_Track.hob** from the **…\Products** folder.

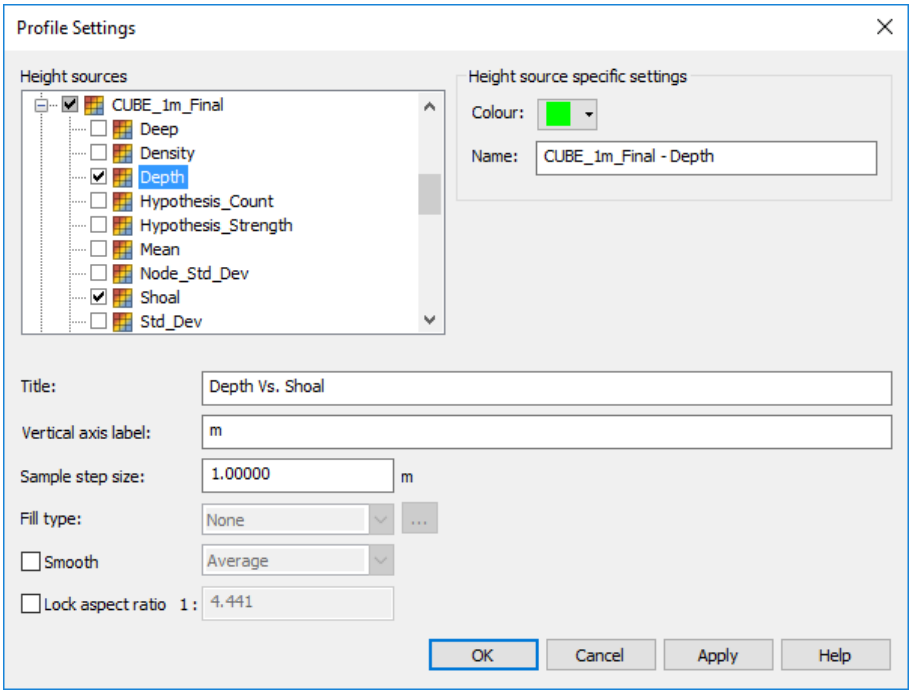
b. Select the **Bathy DataBASE** Catalogue from the drop list.

c. Select the **Recommended_Track** object and choose **Tools > Profile > Cross Profile.**



d. Type **100** for the **Spacing** of the Profile lines, type **75** for both the **Distances to left and right** of the profile lines, to be generated from the selected object. Click **Next.**

Note: The left and right direction depend on the direction in which it was digitized. For Recommended Track object, the first vector was digitized on the east and the final vector was digitized on the west, in this case, Distance to the left would be in a southern direction and distance to right would be in a northern direction.

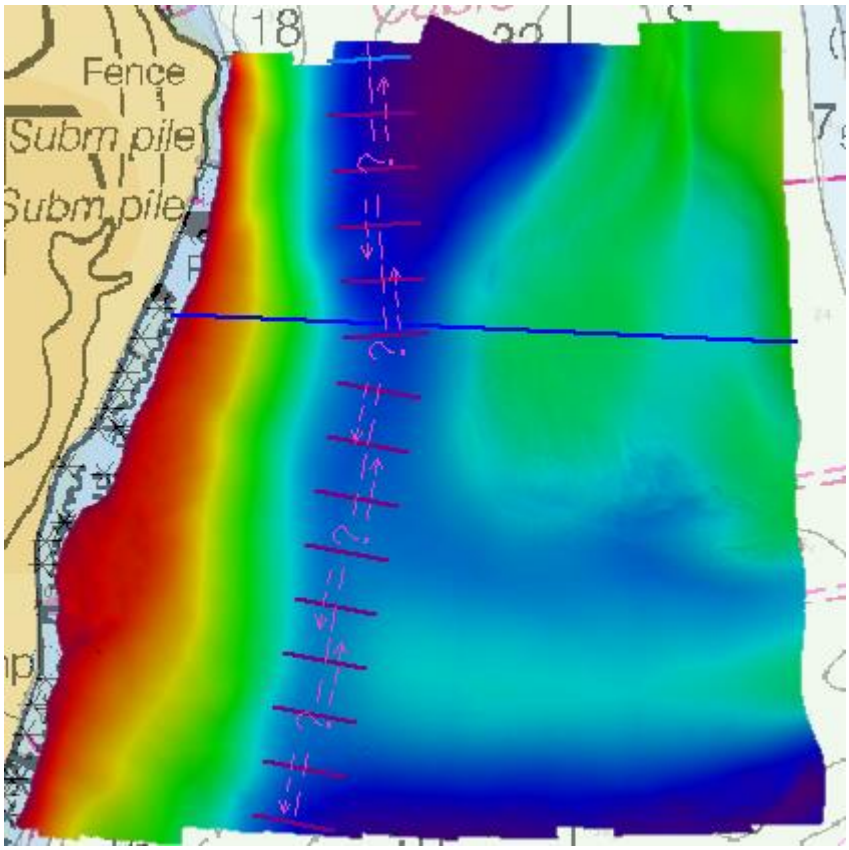


e. In the **Profile Settings** window dialog, under **Height Sources**, enable the **Depth** layer of the **CUBE_1m_Final** surface. Under **Height Source specific settings** assign the **Colour Green**.

f. In the **Profile Settings** window dialog, under **Height Sources**, enable the **Shoal** layer of the **CUBE_1m_Final** surface. Under **Height Sources specific settings**, assign the **Colour Red**.

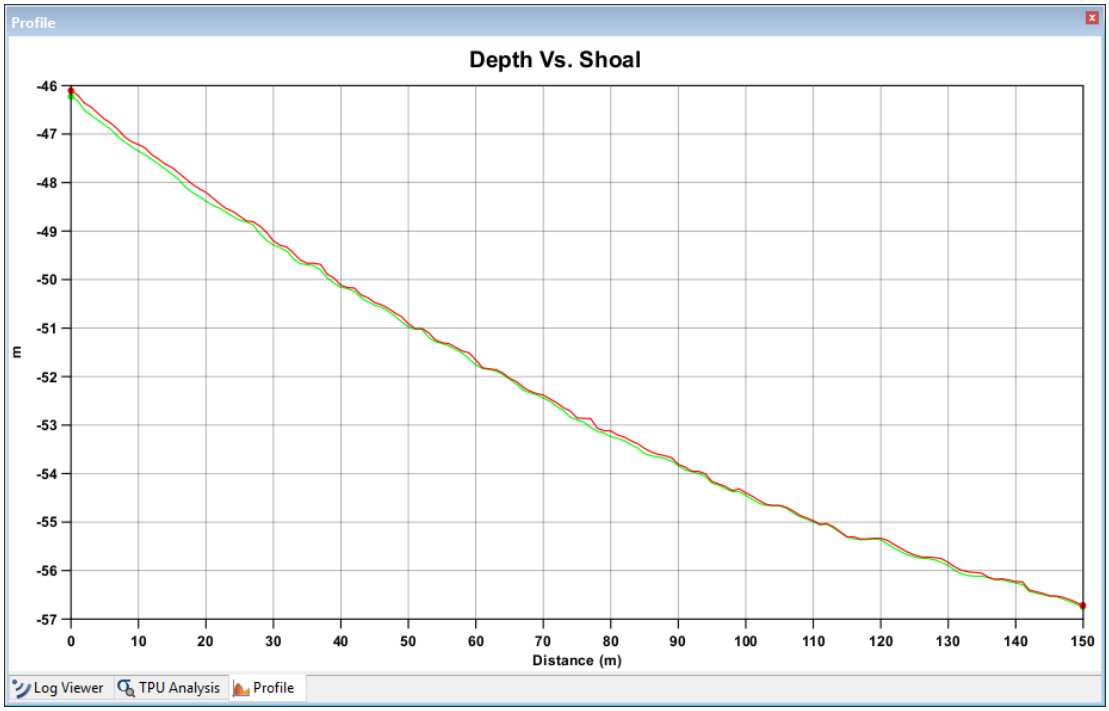
g. Enter the Title **Final Depth Vs. Shoal** for the profile.

h. Enter a Vertical axis label **m** and Sample step size of **1.0**. Click **OK**



i. Within the Output window click the hyperlink, **15 profile lines** to select all of the cross profiles.

j. Click on the first selected object within the Selection window and use the down arrow key to scroll through the additional selected profiles, which can be examined within the Profile window.



k. Right click on the **Profiles** object within **Project** window and select **Close Source** from the drop list. Repeat the same with **Recommended_Track**.

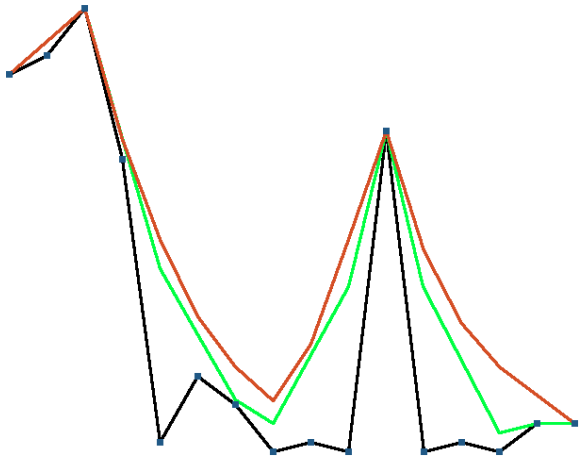
l. Save the project by selecting **File > Save > Save Project…**

Add Smoothed Band

The Add Smoothed Band command is used to apply one of four smoothing algorithms to an input band in a CSAR coverage, generating a new band in the process.

Smoothing a coverage is beneficial because it generalizes the elevation values and reduces the number of contours generated for the coverage, increasing processing efficiency when running other processes.

The following types of smoothing are available:

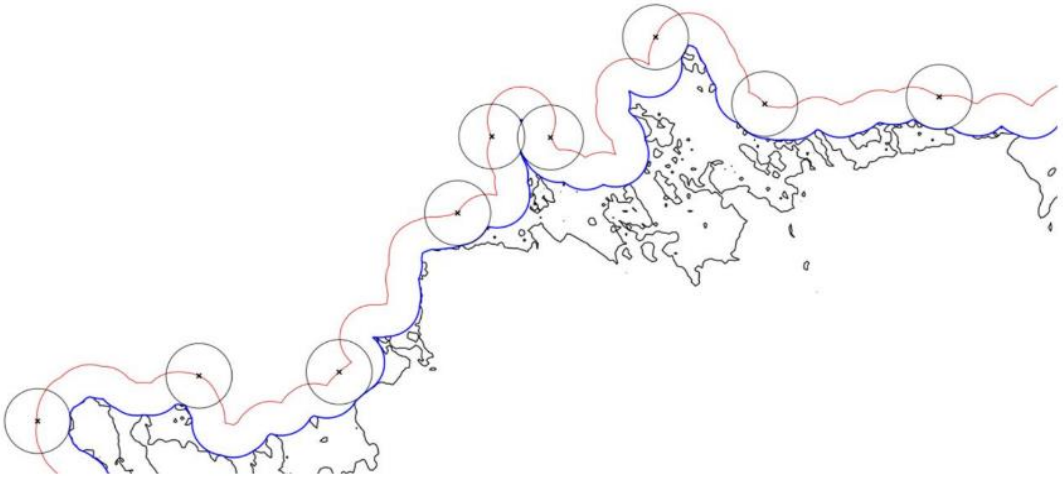


Comparing Cumulative and Restrained

- • **Cumulative Safe Laplacian Smoothing:** Adjusts elevation values to create a smoothed surface suitable for producing generalized contours. This method iteratively compares every point in a coverage to the weighted average of the immediate surrounding points, and raises all points that are deeper than the average of those surrounding points. True position will be maintained if present in the input band. This is useful in reducing overall noise in a coverage.

- • **Restrained Safe Laplacian Smoothing:** Adjust elevation values to create a smoothed surface suitable for producing generalized contours. This method considers each point and its surrounding points in a single iteration, only the initial elevations rather than the raised ones at the surrounding points will be analyzed in the subsequent iterations, resulting in each point only being adjusted once in a given iteration.

- • **Expand Shoals:** Adjusts elevation values to expand shoals, decreasing spikes in data. This method uses radius settings to analyze the elevation values around shoals and move them upwards as needed to reduce variation in depths and still maintain hydrographic safety. Flat areas in the dataset will receiving minimal smoothing and true position will be maintained if present in the input band.

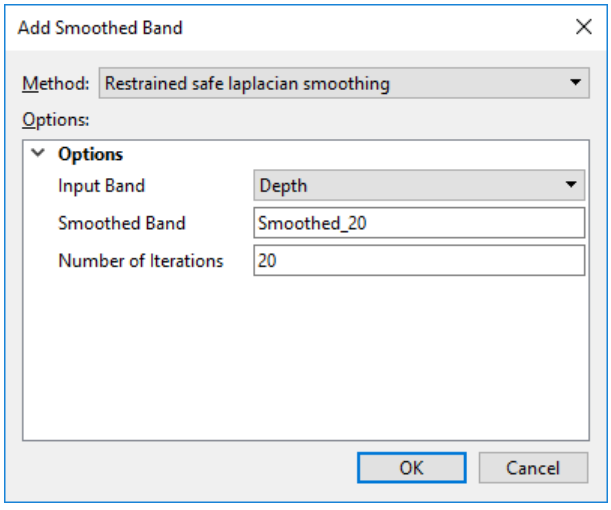


- • **Rolling Coin Smoothing (above):** Adjusts elevation values to generate a shoal-biased surface with a constrained propagation of slope outward from shoals. This method simulates the effect of double-buffering the elevation data in a raster surface. The shoalest points within a specified radius of each point are found as a first pass, and the deepest of the first pass points within the same radius is used as the output for each point.

- **Constrain Slopes:** This method does the rise/run calculations assuming that the maximum slope may be along a diagonal instead of just vertical or horizontal between nodes. In practice, the algorithm is unchanged, but the run is now the square root of two times the value specified.

Exercise 72.

a. Highlight the **CUBE_1m_Final** layer, and select the **Tools> Coverages> Bands> Add Smoothed Band…** menu option.



b. For **Method**, select the **Restrained safe laplacian smoothing** form the drop list.

c. On **Input Band**, leave the **Depth** Band.

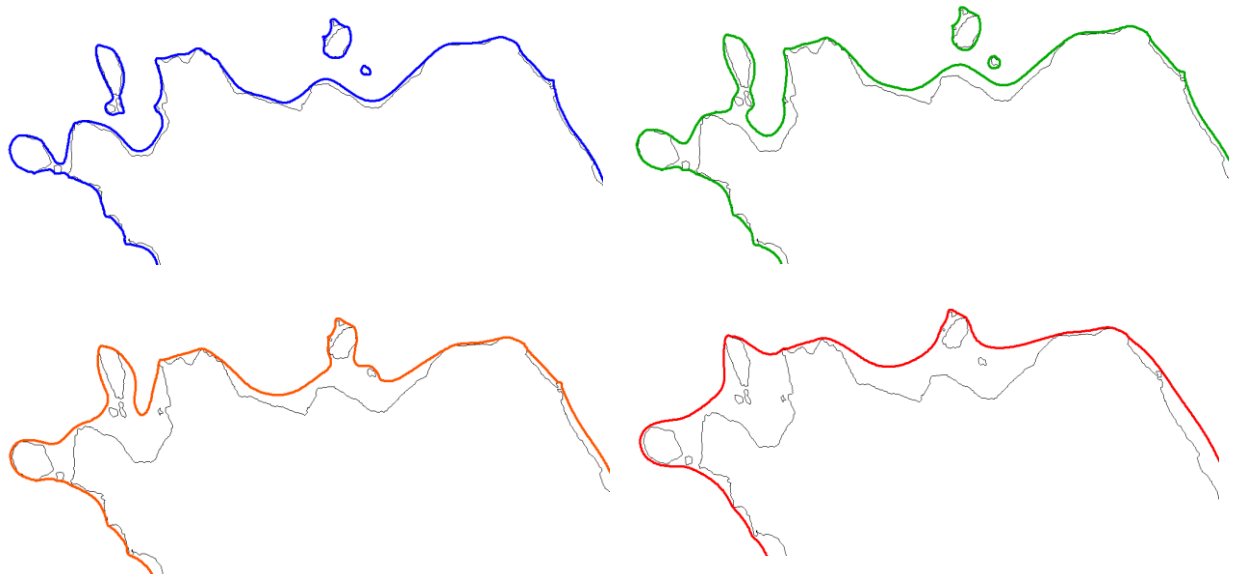
d. On **Smoothed Band**, type **Smoothed_20**.

e. On **Number of Iterations** type **20**.

f. Click **OK**.

Note: The new band generated looks much smoother than the original. The shoals will be maintained and steep slopes and/or single outcrops might be greatly emphasized. Depending on how the smoothed band looks, you may want to try it again with different settings.

Contours generated from an iteratively smoothed surface at a single level, compared with the same contour level on the original surface. Iterations 20, 50, 100, 300.



Comparing Bands

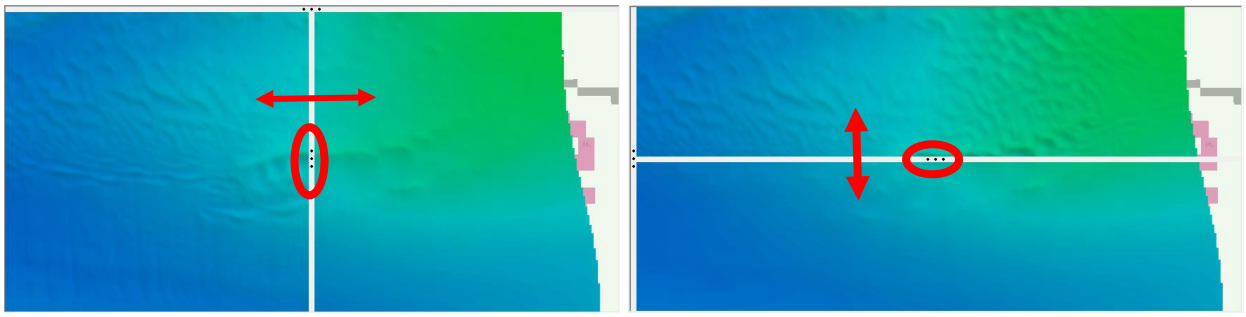
Another two tools of visualization (Swipe and Flicker) allow you to compare different bands from different coverages, in order to see the changes.

The **Swipe** command splits the Display window into two panes so that you can compare the active layer to all other visible layers. Dividers can be moved up and down or left to right to control the display of the compared areas.

Exercise 73.

a. Unfold the **CUBE_1m_Final** object, and on **Project** window. Under **Bands**, you'll see the new created **Smoothed_20** band, make right click there and select **Add Layer**.

b. Highlight the **CUBE_1m_Final – Smoothed_20** layer, and make sure the **CUBE_1m_Final** is enabled too.

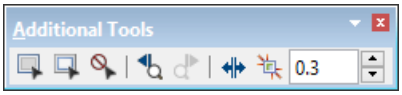


c. Go to the menu **View > Swipe**. Grab the handles on the Vertical divider and move left to right to see the changes between Depth and Smoothed. Alternatively you can see the changes grabbing the handle up and down.

d. Go to the menu **View > Swipe** to turn off the function.

The **Flicker** command turns the active layer on and off very quickly so that differences between it and the other visible layers appear to flicker.

e. Go to the menu **View > Flicker**. It automatically starts to flash between both bands..

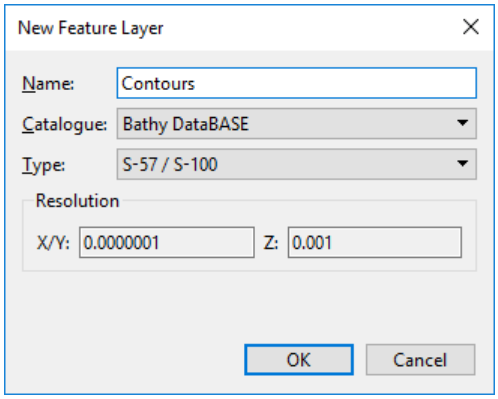


f. On the **Additional Tools** toolbar, you can change the flicker interval values.

g. Also you can enable and disable the tools **Swipe** and **Flicker**. Disable the **Flicker** tool.

Contour Generation

Depth contour lines can be generated from any surface in HIPS. These are cartographic products that might later be used for charting or display. Contours are created using a three-step wizard.



Exercise 74.

a. Click the **New Feature Layer** icon or the **File > New > Feature Layer…** option from the main menu.

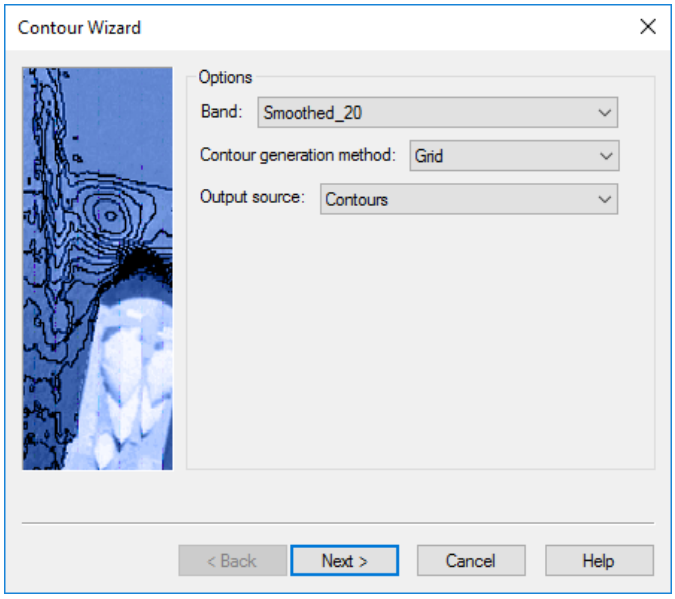
b. Give the name of **Contours**, Catalogue: **Bathy DataBASE[3],** Type: **S-57 / S-100.** Click **OK.**

c. You will see the new layer **Contours** on the **Layers** window**.**

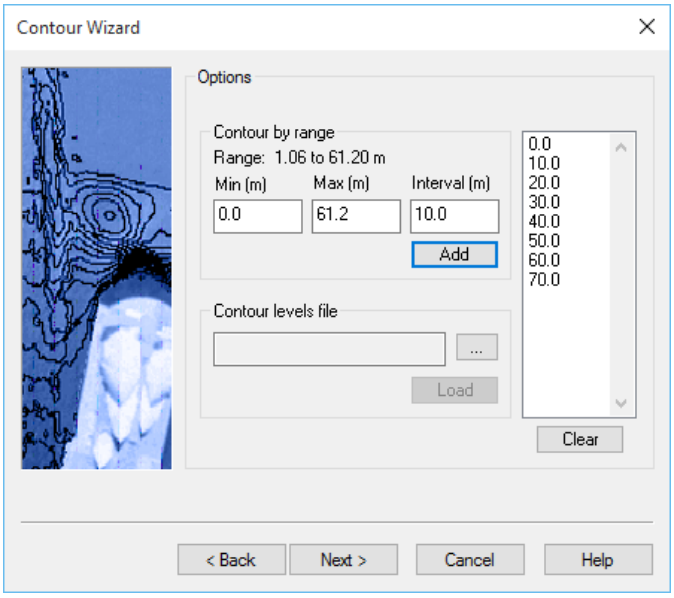
d. Highlight the **CUBE_1m_Final** layer from the **Layers** window. Click the **Contour** icon or the **Tools > Features > Contouring…** option from the main menu.

Contouring from different sources produces different results. The Swath angle Surface or Shoalest Depth True position methods, are mean surfaces, whereas tiles or bins can be shoal-biased. If you are creating products that will be used for navigation, then a bin or uncertainty surface maybe a more appropriate source for generating contours.

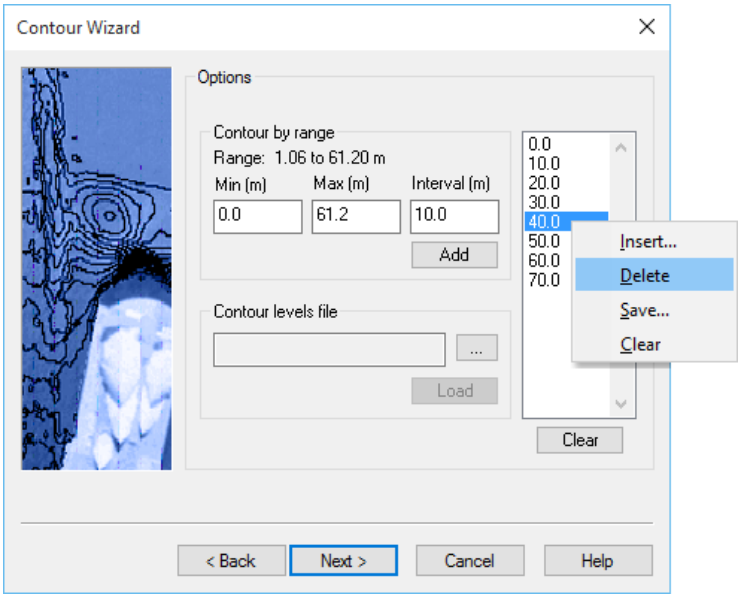
[3] This term is a trademark of Teledyne CARIS, Inc. Reg. USPTO.



e. **Step 1:** Select the **Smoothed_20** as the **Band**, **Grid** as the **Contour generation method** and **Contours** as the **Output layer**, click **Next.**



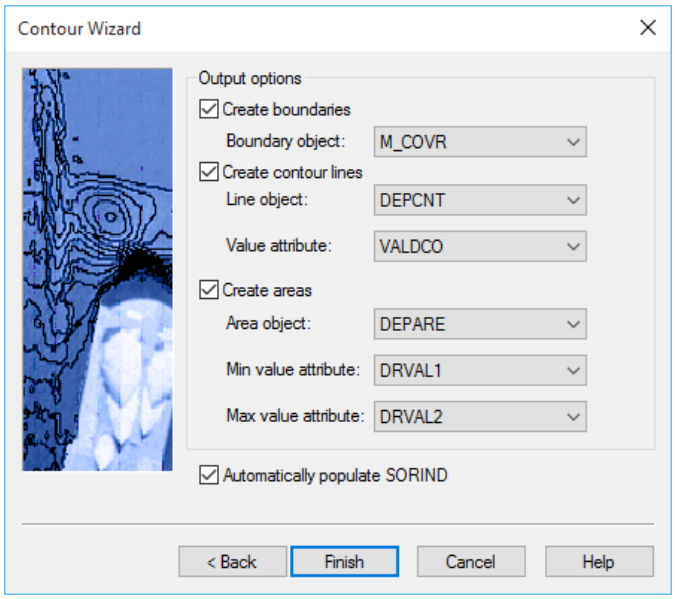
f. **Step 2:** Select an interval of **10** meters and round the Min to **0.00** m and click **Add**. The complete list of contours should be displayed.



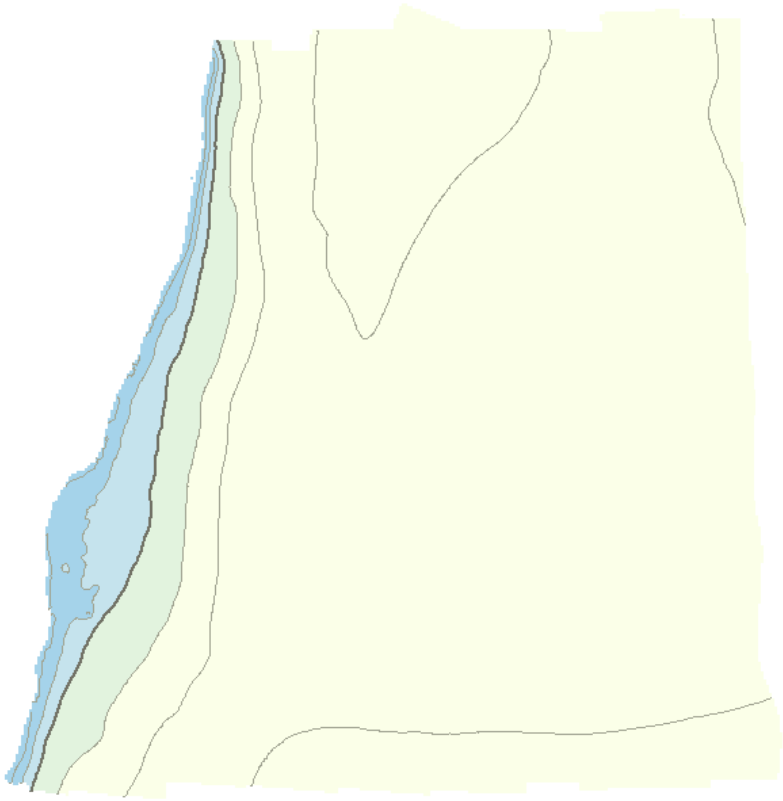
g. Also you can include or delete any of the levels created. **Right-click** the **40.0, 60.0** and **70.0** levels and click **Delete** from the drop list.

h. **Right-click** the **10.0** level and click **Insert…** from the drop list. On the **Add Contour Level** dialog box, type **2 m** and click **OK**. Repeat the process to include **5 m** level. You will see the new levels of 2 m and 5 m added, click **Next**.

Optionally the ranges created here can be stored in a text file, making right click on the ranges loaded window and selecting the option **Save…**



i. Select the Boundary feature as **M_COVR,** Line object as **DEPCNT** and Value Attribute as **VALDCO.** Check the options **Create Areas** and **Automatically populate SORIND.** Click **Finish.**



j. See the **Contours** Layer icon is Gray in the **Layers** window. Click the **Save all** icon or the **File > Save > Save all** menu and save it to **...\Products** folder as **Contours.hob**. After that, the Contours Layer icon will turn blue.

k. Save the project by selecting **File > Save > Save Project…**

Sounding Selection

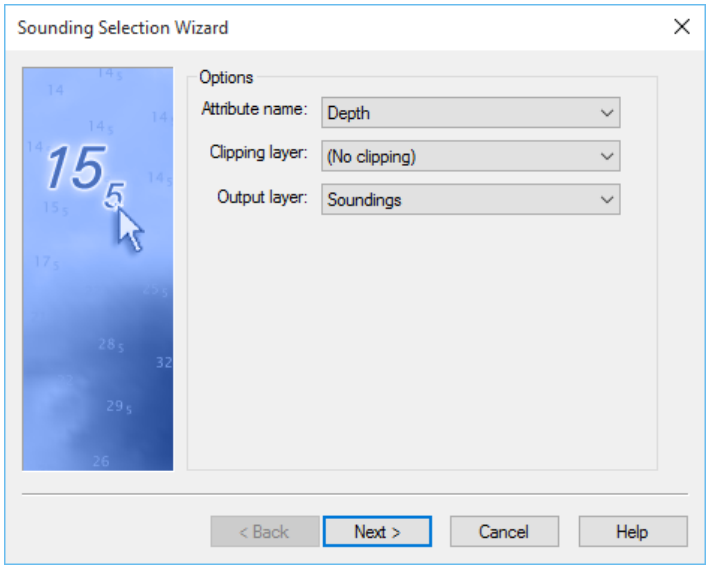
It is impossible to display all soundings produced by a multibeam survey on a map or chart and maintain legibility. The selection of soundings that appear should be dependent on chart scale and purpose. A chart in scale 1:10,000 would contain more soundings than the same size in scale 1:50,000. Soundings can be created from a tile layer or surface.

Exercise 75.

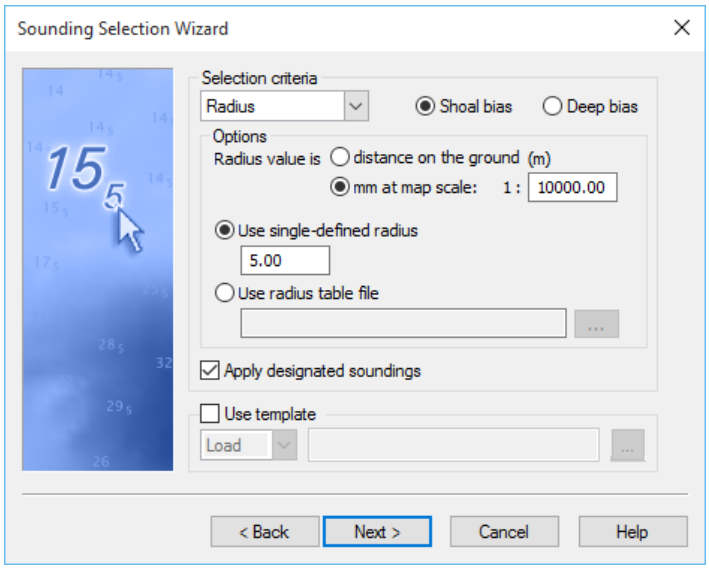
a. Click the **New Feature Layer** icon or the **File > New > Feature Layer…** option from the main menu.

b. Give the name of **Soundings**, Catalogue: **Bathy DataBASE,** Type: **S-57 / S-100.** Click **OK.**

c. Highlight the **CUBE_1m_Final** layer from the **Layers** window. Click the **Sounding Selection** icon or the **Tools > Features > Sounding Selection…** option from the main menu.

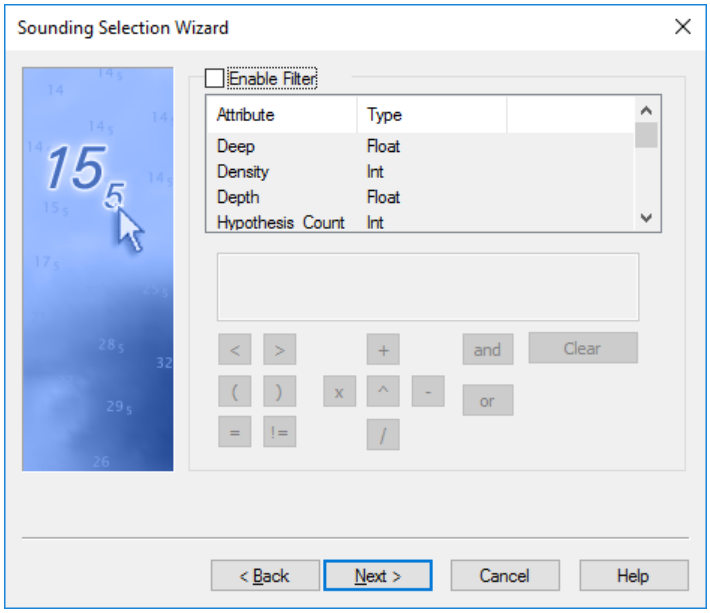


d. Select Attribute name as **Depth** and Output layer as **Soundings,** click **Next.**

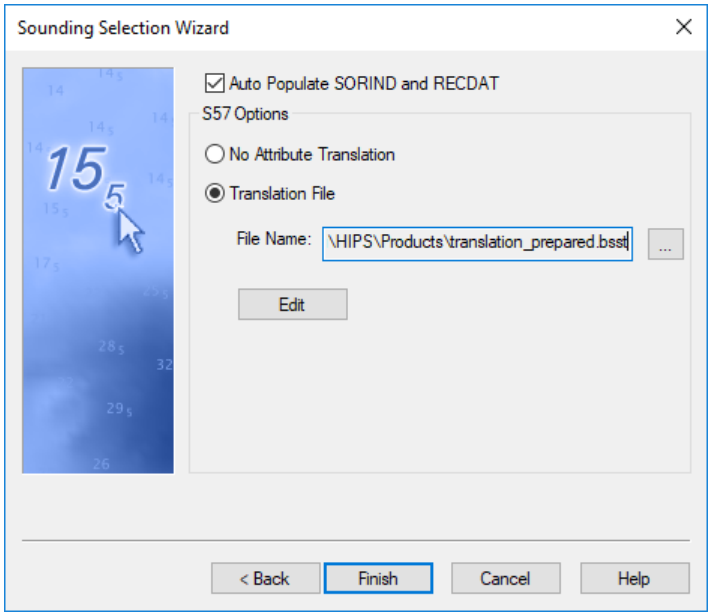


e. Select the **Radius** Selection criteria and choose **Shoal bias**. Radius value is **mm at map scale** at **1:10000**. Enter a **Use Single Defined Radius** value of **5**, **Apply designated soundings** option checked and click **Next.**

Note: The **Apply Designated Soundings** option will look in to the **Designated** Layer of the surface being used to generate soundings.



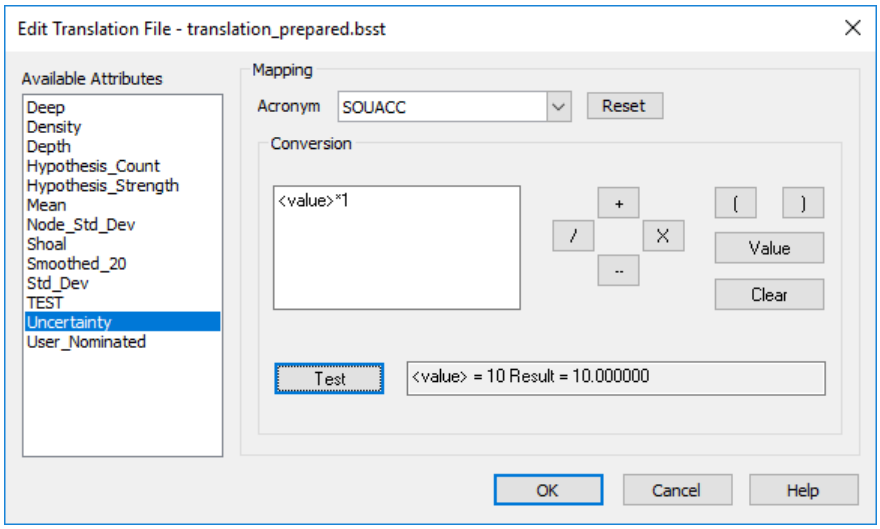
f. Make sure the **Enable Filter** check box is disabled, Click **Next**.



g. Check **Auto Populate SORIND and RECDAT**.

h. Select **Translation File** radio button. Browse (**…**) for the file **translation_prepared.bsst** on the folder **…\Products**.

i. Click on **Edit**



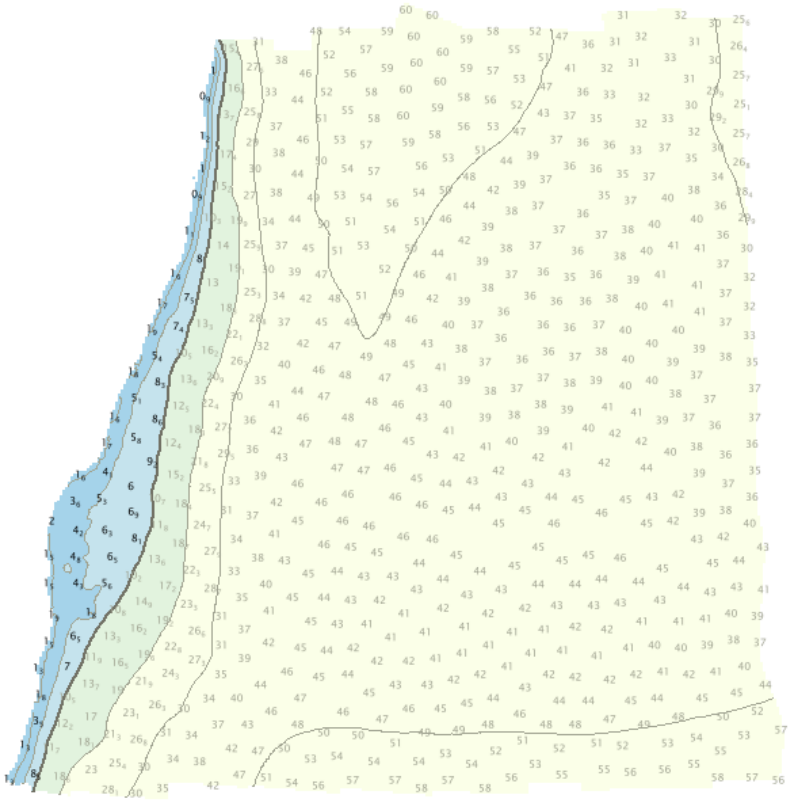
j. On **Edit Translation File** Window, select the Attribute **Uncertainty** from the list.

k. Click on **Test**

The translation file will map the Node **Uncertainty** value to the Sounding Accuracy (**SOUACC**) attribute of each sounding (**SOUNDG**). You must input a conversion and test it, this value from the node attribute (e.g., Uncertainty) will be mapped directly (hence, <value>*1).

l. Click on **OK**

m. Click on **Finish**



n. The **Soundings** layer has been generated. Click the **Save all** icon or the **File > Save all** menu. and save it to **...\Products** folder as **Soundings.hob.** The Soundings layer within the Layers window has changed from grey (objects saved in memory) to blue indicating the sounding objects are now saved within the HOB file.

m. Save the project by selecting **File > Save > Save Project…**

Export Data

Data can be exported from HIPS and SIPS to a variety of formats. It is possible to export HIPS data (bathymetry on the project), surfaces, vector products (i.e. contours and soundings), the Display View, Contacts, and Mosaics.

Export HIPS Project Bathymetry

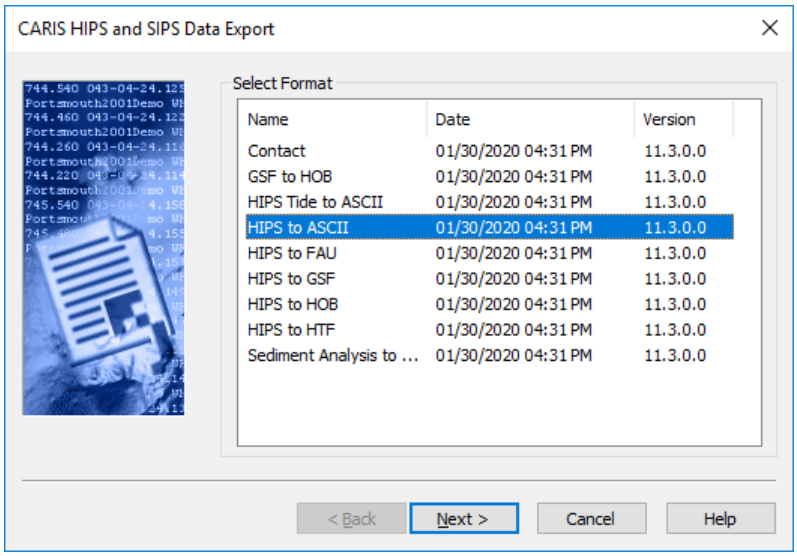
HIPS data (soundings) can be exported to ASCII, FAU, GSF HOB and HTF formats. As well, since HIPS 10.0 release, HIPS data (Processed Depth soundings) can be exported to a CSAR Point Cloud.

HIPS to ASCII

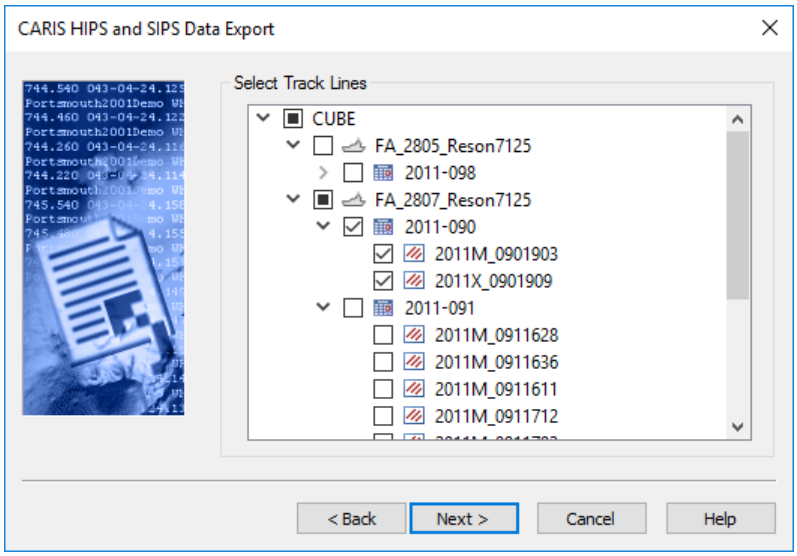
Exercise 76.

a. Select **File > Export > Coverages > HIPS and SIPS Data…** from the main menu or Click the **Data Export** wizard icon from the main toolbar.

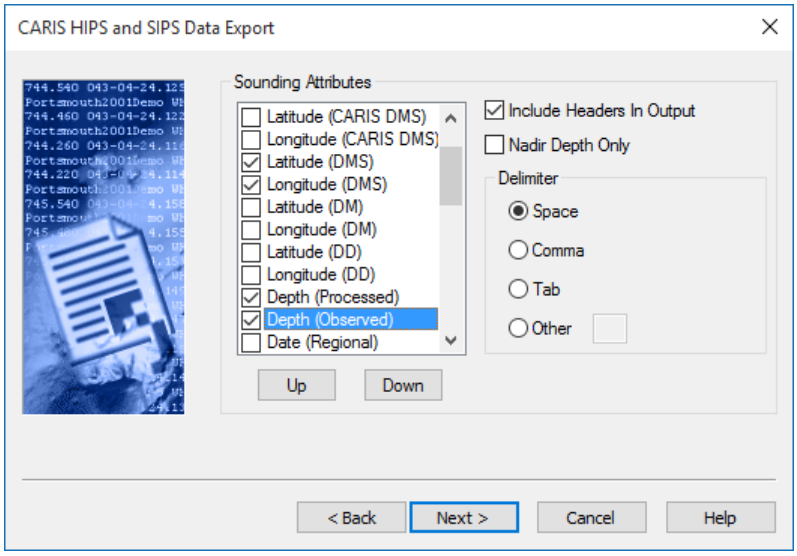
This will launch the **CARIS HIPS and SIPS Data Export** wizard. There are various export options available. This example covers the **HIPS to ASCII** export. The generic ASCII text file can then be used for data transfer**.**



b. Select **HIPS to ASCII** and click **Next**.



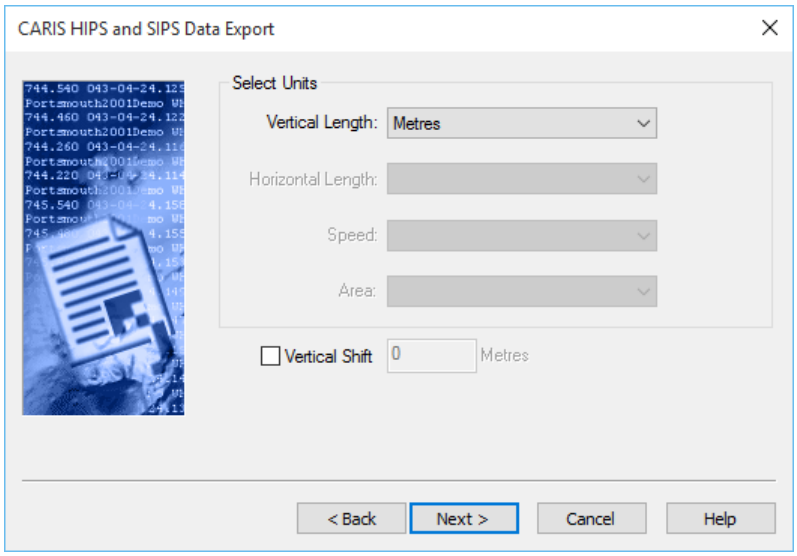
c. Enable **CUBE > FA_2807_Reson7125 > 2011-090** survey day to be exported and click **Next**.



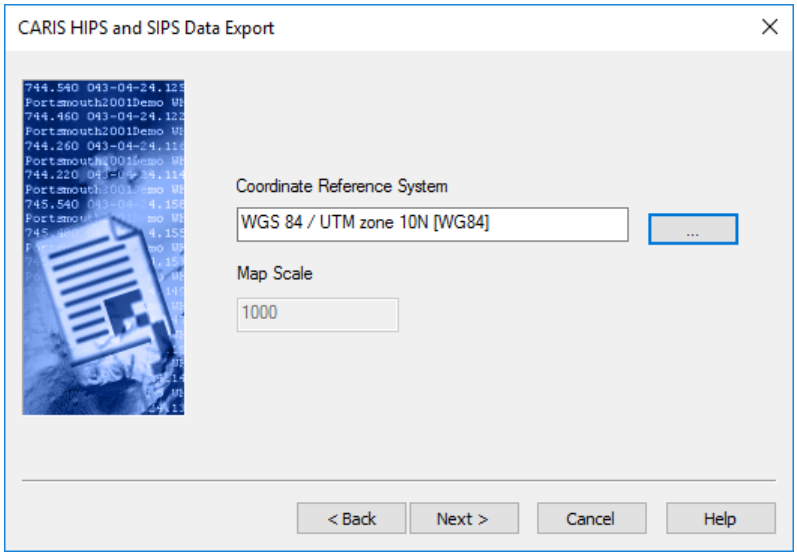
d. Select the following **Sounding Attributes** to be exported to ASCII file: **Latitude (DMS)**, **Longitude (DMS)**, **Depth (Processed)**, **Depth (Observed)** and **Status**.

e. Select **Include Headers in Output** to display column headings in the text file and click **Space** as the **Delimiter.** Click **Next**.

You can change the order that the attributes will be written to the ASCII file by highlighting the attribute in the table and clicking the Up or Down icons.

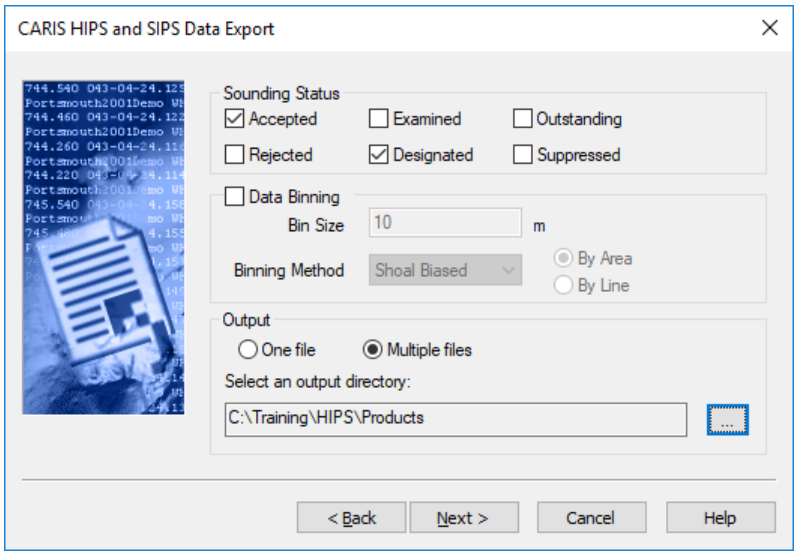


f. Set the **Vertical Length** units to **Metres** and click **Next**.



g. In **Coordinate Reference System,** click Browse (**…**) and select **WGS 84 / UTM zone 10N [WG84] (EPSG:32610)**, click **OK** and click **Next**.

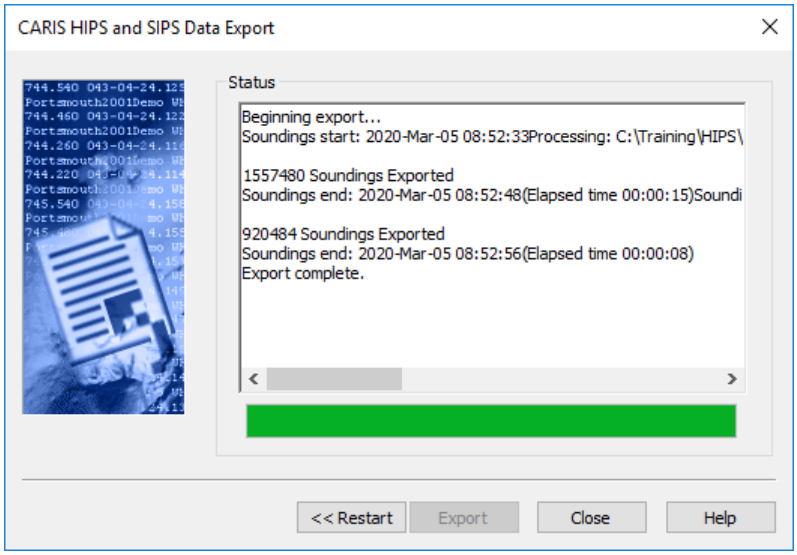
Previously you selected to export the coordinate information as Latitude and Longitude. Therefore, the selected projection will not influence the exported data**.**



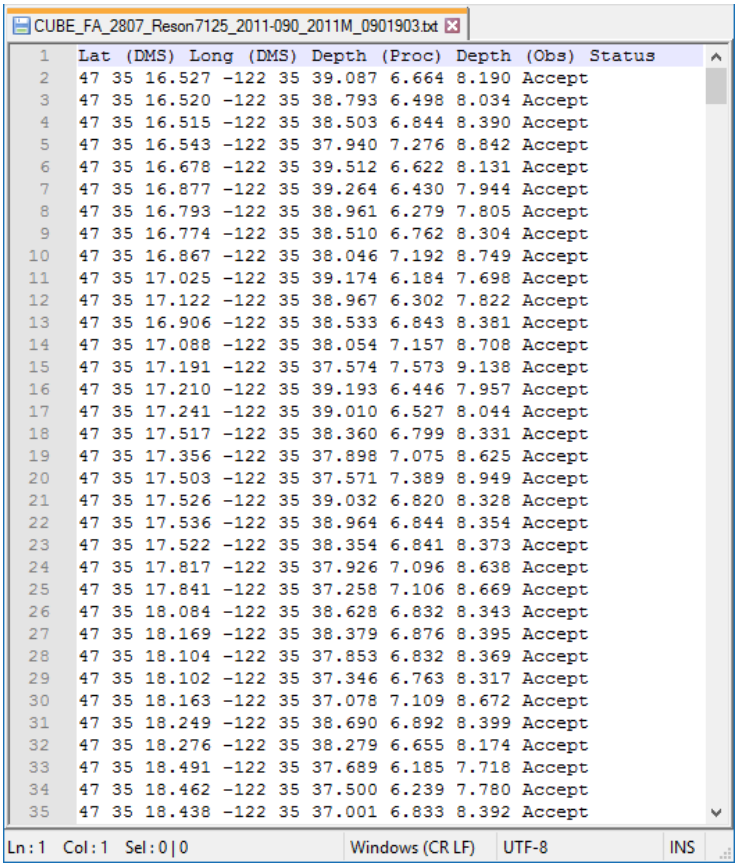
h. Select to include **Sounding Status: Accepted,** and **Designated**.

i. Specify the **Output** as **Multiple Files** and browse to the **…\Products** folder, click **Next**.

By enabling the Data Binning option, a shoal-biased data binning, or thinning, will occur. The shoalest sounding within each specified bin will be selected as the representative soundings and exported to the ASCII file. If Data binning is not enabled all of the processed soundings for the selected lines will be exported to the ASCII file.



j. Step 7: Click **Export** to start the process, and then **Close** the Export wizard when the export is complete.



CUBE_FA_2807_Reson7125_2011-090_2011M_0901903.txt

	Lat (DMS)	Long (DMS)	Depth (Proc)	Depth (Obs)	Status
2	47 35 16.527	-122 35 39.087	6.664	8.190	Accept
3	47 35 16.520	-122 35 38.793	6.498	8.034	Accept
4	47 35 16.515	-122 35 38.503	6.844	8.390	Accept
5	47 35 16.543	-122 35 37.940	7.276	8.842	Accept
6	47 35 16.678	-122 35 39.512	6.622	8.131	Accept
7	47 35 16.877	-122 35 39.264	6.430	7.944	Accept
8	47 35 16.793	-122 35 38.961	6.279	7.805	Accept
9	47 35 16.774	-122 35 38.510	6.762	8.304	Accept
10	47 35 16.867	-122 35 38.046	7.192	8.749	Accept
11	47 35 17.025	-122 35 39.174	6.184	7.698	Accept
12	47 35 17.122	-122 35 38.967	6.302	7.822	Accept
13	47 35 16.906	-122 35 38.533	6.843	8.381	Accept
14	47 35 17.088	-122 35 38.054	7.157	8.708	Accept
15	47 35 17.191	-122 35 37.574	7.573	9.138	Accept
16	47 35 17.210	-122 35 39.193	6.446	7.957	Accept
17	47 35 17.241	-122 35 39.010	6.527	8.044	Accept
18	47 35 17.517	-122 35 38.360	6.799	8.331	Accept
19	47 35 17.356	-122 35 37.898	7.075	8.625	Accept
20	47 35 17.503	-122 35 37.571	7.389	8.949	Accept
21	47 35 17.526	-122 35 39.032	6.820	8.328	Accept
22	47 35 17.536	-122 35 38.964	6.844	8.354	Accept
23	47 35 17.522	-122 35 38.354	6.841	8.373	Accept
24	47 35 17.817	-122 35 37.926	7.096	8.638	Accept
25	47 35 17.841	-122 35 37.258	7.106	8.669	Accept
26	47 35 18.084	-122 35 38.628	6.832	8.343	Accept
27	47 35 18.169	-122 35 38.379	6.876	8.395	Accept
28	47 35 18.104	-122 35 37.853	6.832	8.369	Accept
29	47 35 18.102	-122 35 37.346	6.763	8.317	Accept
30	47 35 18.163	-122 35 37.078	7.109	8.672	Accept
31	47 35 18.249	-122 35 38.690	6.892	8.399	Accept
32	47 35 18.276	-122 35 38.279	6.655	8.174	Accept
33	47 35 18.491	-122 35 37.689	6.185	7.718	Accept
34	47 35 18.462	-122 35 37.500	6.239	7.780	Accept
35	47 35 18.438	-122 35 37.001	6.833	8.392	Accept

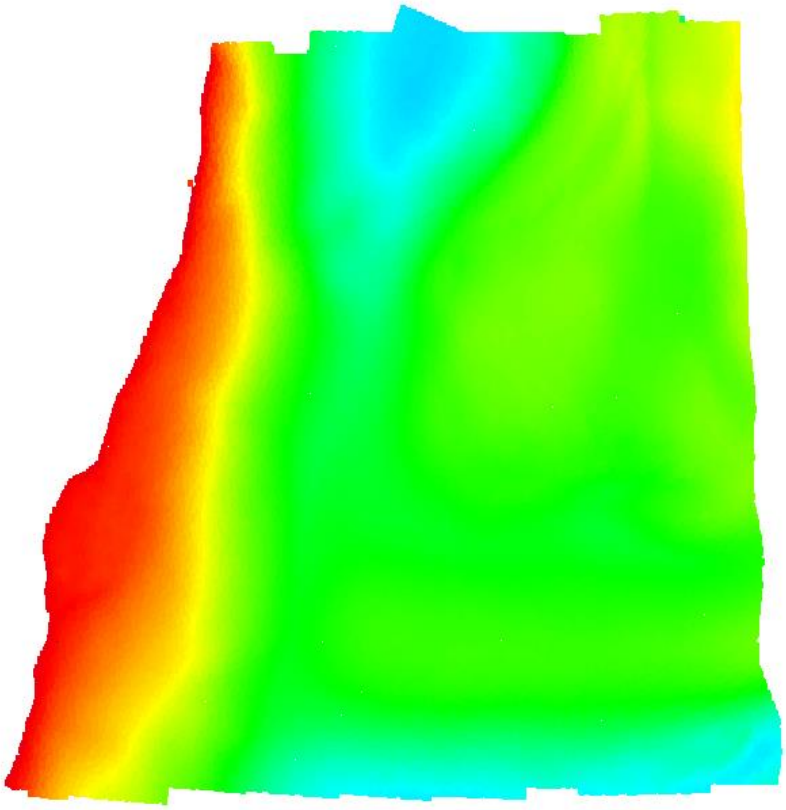
Ln : 1 Col : 1 Sel : 0 | 0 Windows (CR LF) UTF-8 INS

You can check the results on any Text Editor opening the exported .txt files.

Exercise 77.

a. Right click on **CUBE Track Lines** within **Layers** window and select the option **Save as…** from the drop list.

b. Save the resultant Csar file (Point Cloud) as **CUBE_PC** in **…\Coverages** folder.



c. Open the surface CUBE_PC from the **…\Coverages** folder.

This Point Cloud Surface will contain all (Accepted and Designated) soundings from the HIPS project.

d. Save the project by selecting **File > Save > Save Project…**

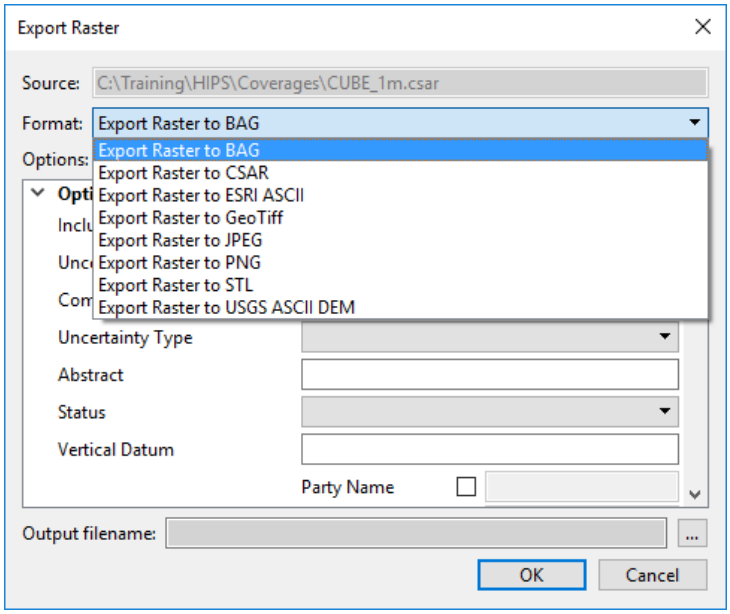
Export Surface

The surfaces generated in HIPS and SIPS can be exported to ASCII, Raster formats (DEM's) and Raster Images (using the tool Render Raster to Image).

Surface Raster (DEM) Formats

The following exercise will show how you can export a surface to BAG raster format. The list also includes these additional formats:

- **BAG**
- **CSAR**
- **ESRI ASCII**
- **GeoTiff**
- **JPEG**
- **PNG**
- **STL (for 3D printers)**
- **USGS ASCII DEM**

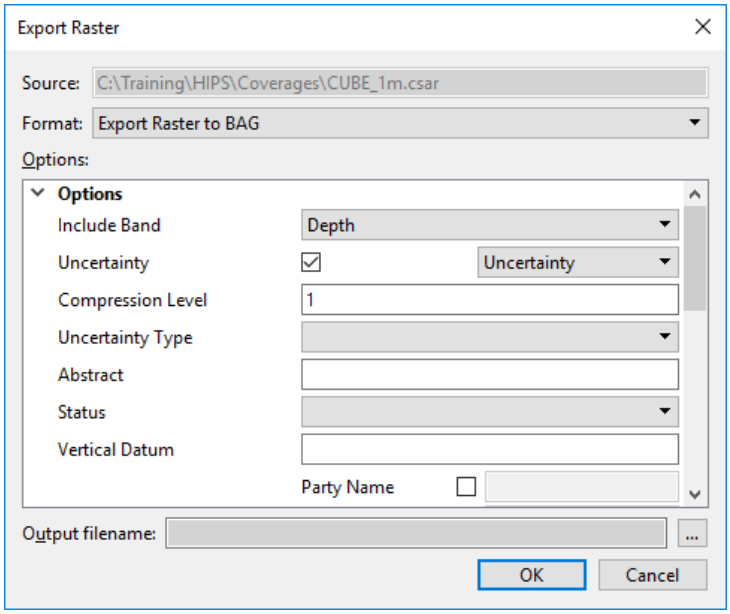


Exercise 78.

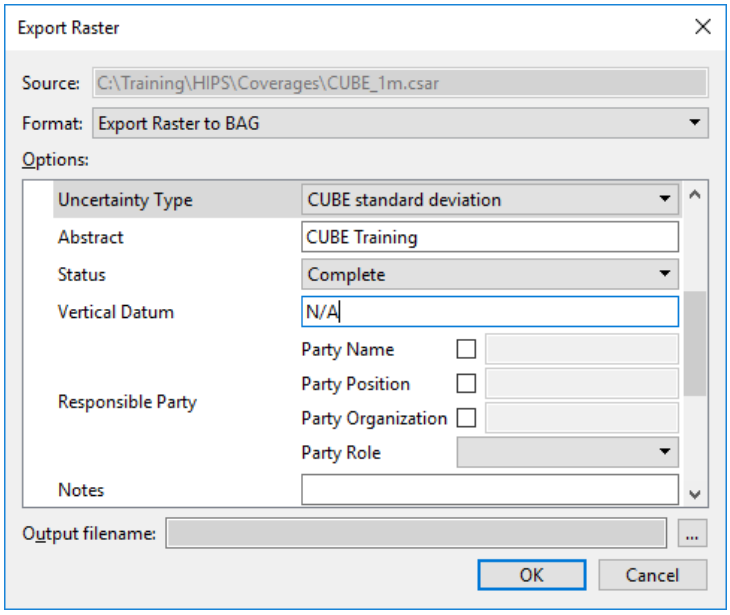
a. Highlight the **CUBE_1m** layer within **Layers** window.

b. Choose **File > Export > Coverages > Raster…**

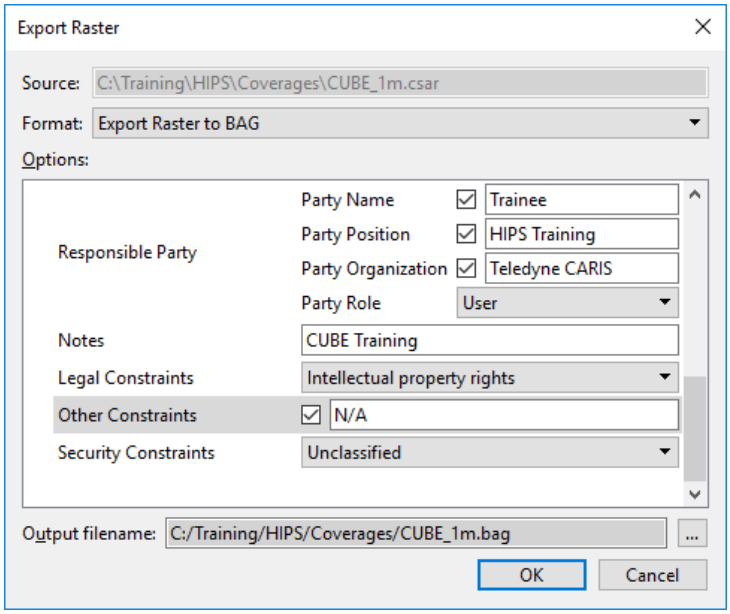
c. Select **Export Raster to BAG** from the **Format** drop list.



d. Under **Options** select **Depth** as **Include Band**, turn on the checkbox for **Uncertainty** and select **Uncertainty** from the drop list, leave the **Compression Level** as **1**.



e. Under **Metadata** select **CUBE standard deviation** from **Uncertainty Type** drop list, type **CUBE Training** as the **Abstract**, select **Complete** from **Status** drop list and type **N/A** in **Vertical Datum.**



f. Under **Responsible Party,** type **Trainee** (or your name) on **Party Name**, **HIPS Training** as the **Party Position**, **Teledyne CARIS** as the **Party Organization** and select **User** from the **Party Role** drop list. Type **CUBE Training** as the **Notes**.

g. Under **Constraints**, select **Intellectual Property rights** from **Legal constraints** drop list, type **N/A** for **Other Constraints** and select **Unclassified** from **Security Constraints** drop list.

h. Save the resulting BAG file as **CUBE_1m.bag** on **…\Coverages** folder. Click **OK**.

Opening the BAG file, you can check that it looks the same as the original CUBE surface.

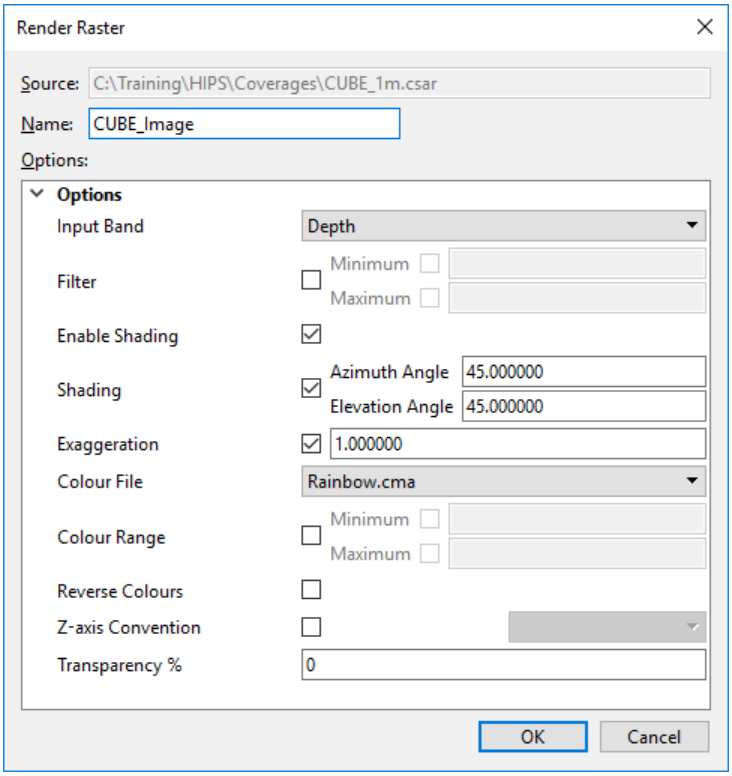
Surface Raster to Image

This exercise will show how you can export a surface to Image format. The Render Raster to Image command exports a single band from a raster surface to a raster image. It will export the values from the selected band into colours.

Exercise 79.

a. Highlight the **CUBE_1m** layer within the **Layers** window.

b. Choose **File > Export > Coverages > Image…**



c. Type **CUBE_Image** as the **Name**.

d. Select the **Depth** layer from the **Input Band** drop list.

e. Leave the **Enable Shading**, **Shading**, **Exaggeration** and **Colour File** options by default.

In this step, any features of the exported image can be configured, like Depth Filters, Shading, Vertical Exaggeration, Different Colour Files (Maps or Ranges), Reverse Colours and Transparency level.

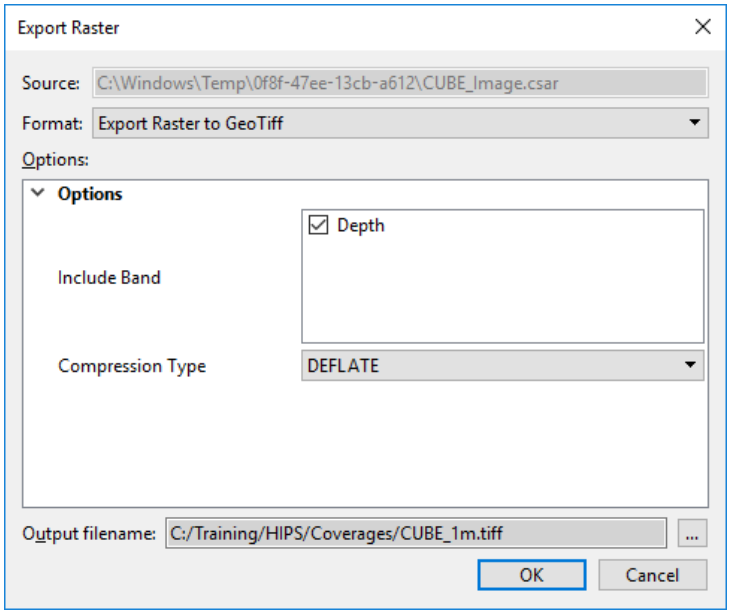
f. Click **OK**.

The Raster Image will be added to the current display.

Note: The layer on these Raster Images is represented by a Photo icon, instead of the Surface Icon for the same layer on all other DEM Raster Surfaces.

The raster image is created in memory only and will be lost when the application or the layer is closed. If you wish to retain the new image file, it can be exported as raster.

i. In **Layers** window, select the **CUBE_Image** Raster image and select **File > Export > Coverages > Raster…** menu



g. Select **Export Raster to GeoTiff** from the **Format** drop list.

h. Enable the layer **Depth** on **Include Band**

i. Leave **Compression Type** as **DEFLATE**

j. Save the resulting Tiff file as **CUBE_1m.tiff** on **…\Coverages** folder. Click **OK**.

Export Vector Data to Shape File

Contours and selected soundings layers can be exported to a **Shape** file from HIPS and SIPS. When exporting to this format and other formats like DXF, the Coordinate system of the Display window is used. Therefore prior to exporting make sure you check the current coordinate system and if necessary make the appropriate changes.

Exercise 80.

a. Set the coordinate system for export. **View > 2D View Properties…** On **Coordinate reference system:** select **WGS 84 / World Mercator (EPSG:3395),** Click **OK.**

b. Highlight the **Soundings** layer in the Layers window and choose **Select > All.**

c. Then choose **File > Export > Selection > Shape File...**

d. Save it as **Soundings.shp** in **…\Products** folder.

The report of the export will appear on the **Output** window.

Appendix A: Additional Utilities

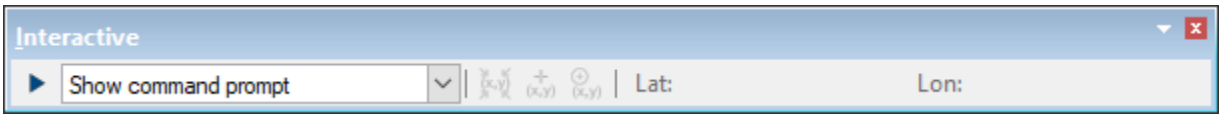
CARIS HIPS and SIPS includes several additional utilities to assist you in various tasks outside of the normal workflow:

- CARIS Batch
- Configuration Reporter
- Command Line GUI
- Dump utilities
- Print utilities

CARIS Batch

With the release of HIPS and SIPS 10.0 CARIS Batch tools are available. The CARIS Batch utility runs command-line processes on marine products generated from CARIS applications. CARIS Batch is installed in the \Bin folder of a CARIS application.

To run carisbatch go to **View** > **Toolbars** and click **Interactive** to open;



With the drop-down of **Show command prompt** selected click the Run icon to open Command Prompt.

The basic syntax for carisbatch is:

```
carisbatch --run <process_name> <parameters> <input> <output>
```

The -r key or --run parameter is required to run a process. Processes are bound by the following rules:

- Parameters are identified either by character keys or parameter names. Keys use a single-hyphen prefix (-h) and parameter names use a double-hyphen prefix (--help).
- Values are separated from parameters by a space (e.g. -n 6).
- Parameter values with spaces must be enclosed in quotation marks (e.g. -c "New DSID Comment").
- Process names are not case-sensitive, but parameter names are. Be careful when entering parameters.

Processes available to run in CARIS Batch (HIPS) are (type **carisbatch -l** and click enter):

Grouped Processes:

- AddToSIPSMosaic
- ContourRaster
- CreateHIPSGrid
- CreateSIPSBeamPattern
- CreateSIPSMosaic
- CreateVRSurface
- DifferenceCoverages
- ExportCoverageMetadata
- ExportHIPS
- ExportPoints
- ExportRaster
- ImportHIPSFromAuxiliary
- ImportToHIPS
- ImportVRSurface
- PopulateVRSurface
- ShiftElevationBands
- SoundVelocityCorrectHIPS
- SplitCoverage

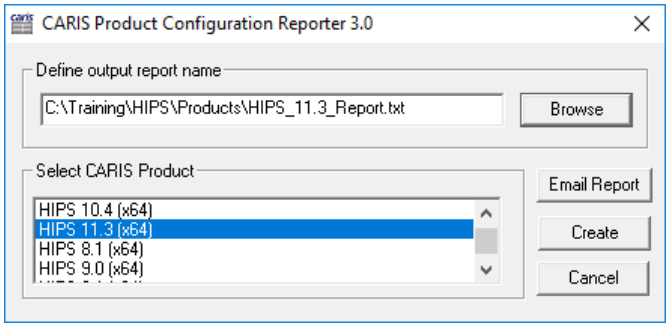
- AddComputedBand
- AddFeatures
- AddKrakenTILToMosaic
- AddSmoothedBand
- AddToHIPSGrid
- AddToVRSurface
- ChangeFeatureAttributes
- ClassifyHIPSNoise
- ClassifyRasterHolidays
- ClipFeatures
- ClipRaster
- ComputeHIPSBoresightCalibration
- ComputeHIPSSeparationModel
- ComputeSIPSTowfishNavigation
- CopyHIPSToHIPS
- CopyToCSAR
- CreateFeatureRelationships
- CreateHIPSFile
- CreateHIPSVesselFile
- CreateSoundingsFromCoverage
- DeleteFeatures
- DetectHIPSCriticalSoundings
- DissolveFeatures
- EraseFeatures
- ExportCoverageToASCII
- ExportFeaturesToShapefile
- ExportToWKT
- ExportVRSurfaceToBAG
- ExtractCoverage
- FillRasterHolidays
- FilterCoverage
- FilterFeatures
- FilterHIPSAttitude
- FilterObservedDepths
- FilterProcessedDepths
- FinalizeRaster
- FinalizeVRSurface
- GeneralizeRaster
- GeoreferenceHIPSBathymetry
- ImportGenericToHIPS
- ImportKrakenTILToMosaic
- ImportMultipleDetectionsToHIPS
- MoveHIPSToHIPS
- RecomputeHIPSGrid
- RemoveFromHIPSGrid
- RemoveFromSIPSMosaic
- RemoveFromVRSurface
- RenderRaster
- RepairCoverage
- ResampleSurfaceToRaster
- ResetHIPSStatus
- ScaleHIPSAttitude
- SetHIPSNavigationSource
- ShiftHIPSNavigation
- SimplifyFeatures
- SmoothFeatures
- TileRaster
- UpdateFeatures
- UpdateHIPSAdditionalBathymetry
- UpdateRasterCUBEDisambiguation
- UpdateSIPSContactPositions
- UpdateVRCUBEDisambiguation
- UpgradeHIPSandSIPSDataStructure
- ValidateCoverage
- VectorizeRaster

To consult the specific parameter for each process in CARIS Batch, please refer to CARIS Batch Utility Reference Guide, included on HIPS Documentation.

Configuration Report

A useful tool to help diagnose problems in the HIPS and SIPS system setup is the configuration report. If problems occur and you need support, run this tool, create the report and email it with description of the issue to CARIS Customer Support.

This utility can be run on any CARIS product installed on the computer.



The items included in the report are as follows:

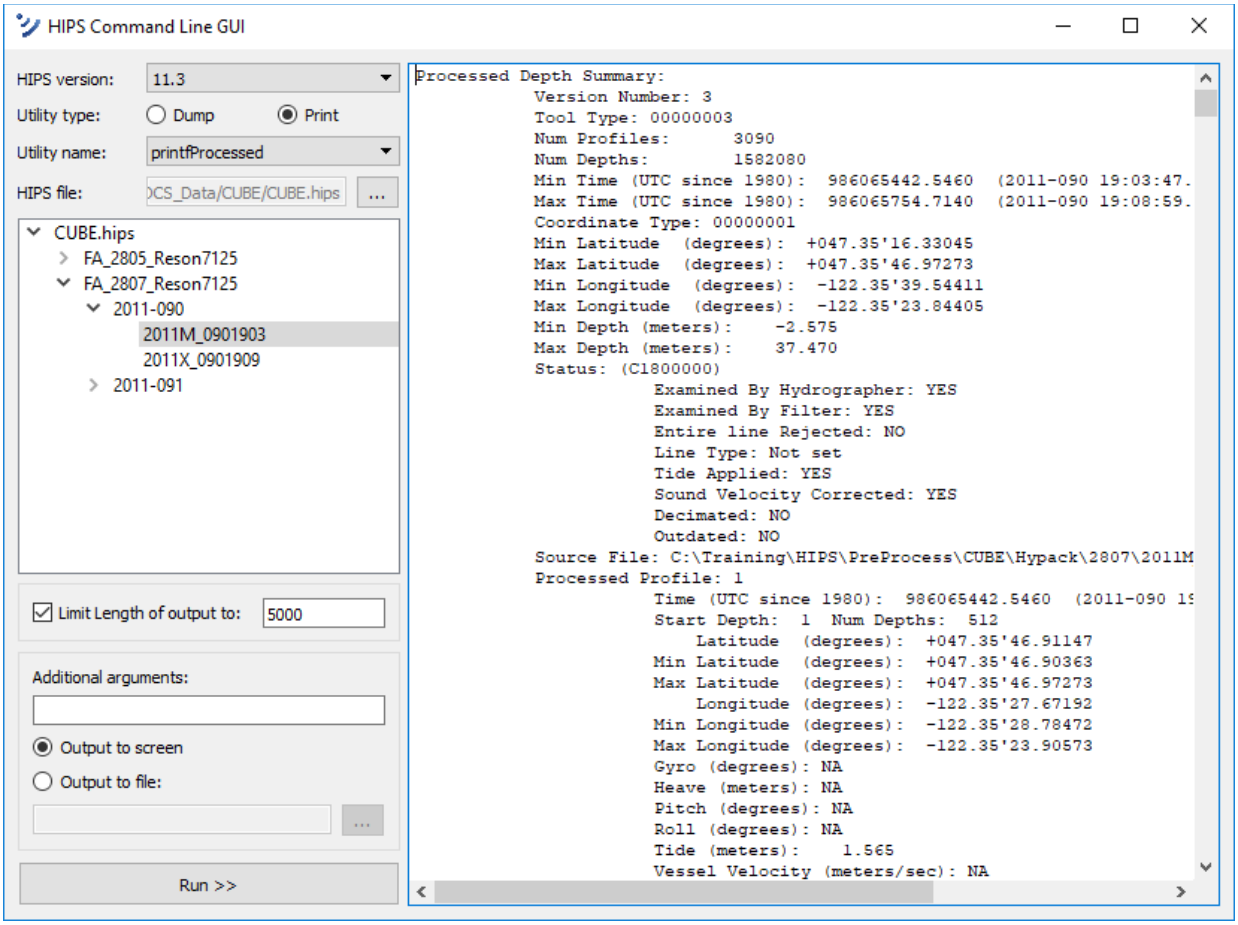
- Program, Version, and Link Date
- Environment
- System Information
- System and User's Environment
- CARIS Licensing Report

Command Line Utilities

You have the option to write out raw data formats to ASCII or HIPS data formats to ASCII using command line utilities installed with HIPS and SIPS. These command line utilities can be run from a cmd window or by using the Command Line Utilities GUI.

Command Line Utilities GUI

Visit the CARIS Online Customer Services website to download the Command Line Utility GUI, which can run all printf and dump commands within a user-friendly interface.



Exercise 81.

a. Open the **Command Line GUI**

b. Select Utility Type **Print** and Utility Name **printfProcessed**.

c. Select the HIPS file **C:\Training\HIPS\HDCS_Data\CUBE\CUBE.hips**

d. Expand the Project **CUBE > FA_2807_Reson7125 > 2011-090** and select a line.

e. **Output to Screen** is selected by default, click **Run** to view the Navigation data within the selected line folder.

Similarly, raw data formats can be "dumped" to an ASCII file or to the screen. There is no exercise showing this here because the raw data used in this training is Hypack *.hsx format, which is already ASCII.

'Dump' Commands

The dump commands will write raw data formats to an ASCII file. The following shows an example of dumping an XTF file to a text file.

Exercise 82.

a. Go to **Start > All Apps > CARIS > HIPS and SIPS 11.3 Command Prompt…** This will open a command prompt window.

b. Change directories to the Pre-process folder where the XTF data is stored.

Write the xtf to a text file in the same directory:

```
dumpxtf "linenumber.xtf" > linenumber.txt
```

This will create a text file of the raw xtf data in the same folder as the raw xtf file. Note that you can also specify a path to where you would like the text file saved. Open the text file in a text editor.

'Print' Commands

The Print commands will write HIPS HDCS data to an ASCII file. In the following example the Observed depths of an HDCS line will be written to a text file.

Exercise 83.

a. Go to **Start > All Apps > CARIS > HIPS and SIPS 11.3 Command Prompt…** This will open a command prompt window.

b. Change directories to the folder where you would like to save the output text file. There is no need to change directories to the Project data folder.

Write the data to a text file in the same directory:

```
printfObserved C:\Training\HIPS\HDCS_Data\CUBE\FA_2807_Reson7125\2011-090\2011M_0901903 > Observed_textfile.txt
```

This will create a text file of the Observed depths of a single line in the HDCS directory. Open the text file in a text editor.